Reimagining health information exchange in India using blockchain

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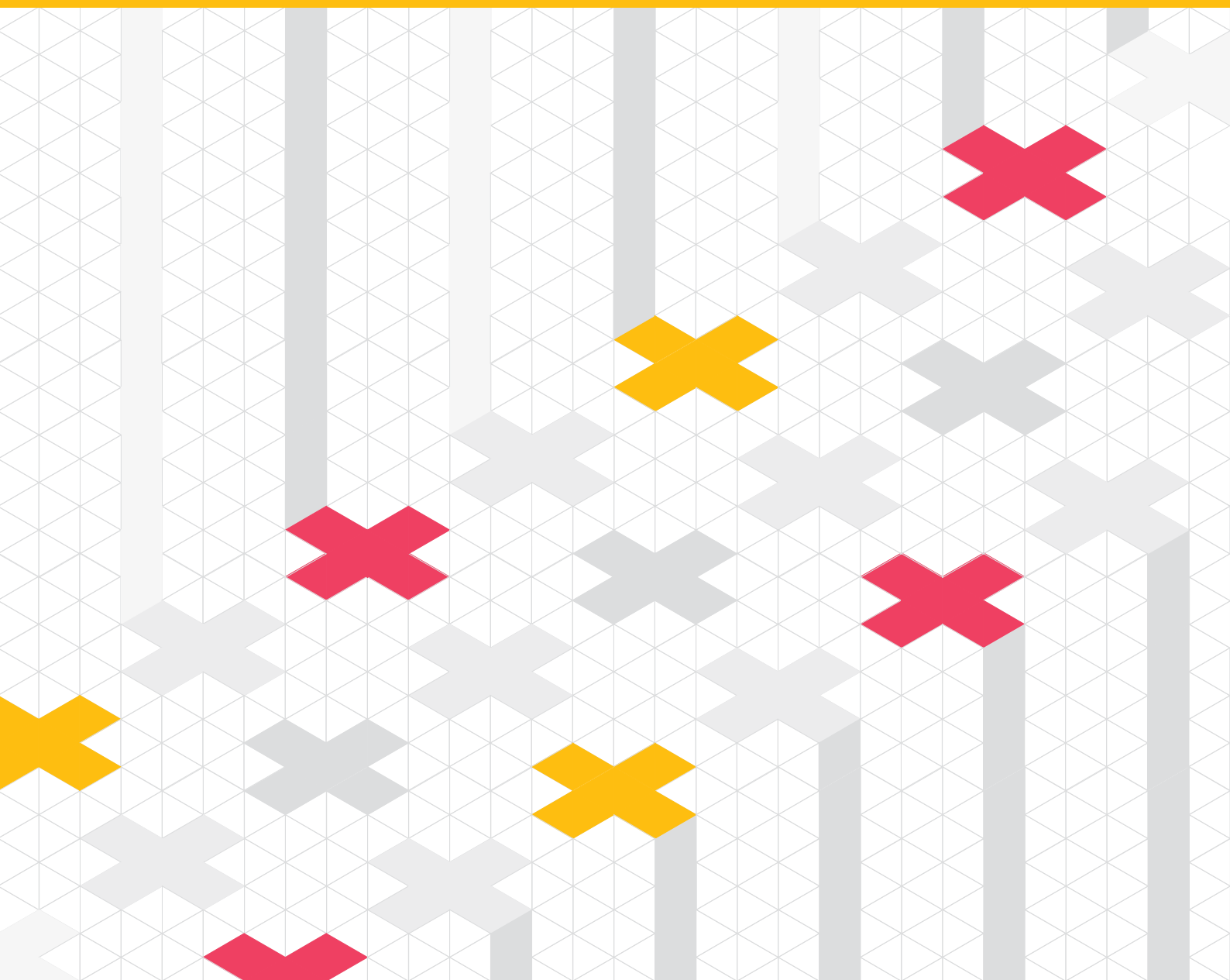

Foreword

The healthcare industry in India has long been faced with multiple challenges: making healthcare affordable, availability of sufficient healthcare resources and below-par patient experience.

Technological advancement in recent years has led to increased adoption of information technology and connected the operational technology of healthcare providers globally. It has also increased adoption of home-care and fitness-tracking devices by patients and enabled healthcare insurers to mass-personalise their products. At the same time, social media has increased awareness of the high standards of technology-led healthcare and patient experience across the world, raising the expectations of all these stakeholders from the Indian healthcare sector.

Seamless sharing of information between providers will ensure faster and more accurate diagnoses and more effective treatments for patients. It will also increase the overall ability of providers to make care delivery cost-effective and improve the overall patient experience. The use of unique digital signatures to authenticate information makes blockchain a secure encoded technology, and it could be the answer to the Indian healthcare industry's legacy challenges. Blockchain can allow stakeholders in the healthcare ecosystem to share patient, treatment and clinical information without compromising on security by ensuring information origin as well as change tracking.

As the Indian healthcare ecosystem considers the adoption of blockchain, it is imperative to establish a country-wide information exchange of electronic health records (EHRs) at the very outset.

On the one hand, distributed and connected systems have the potential to open new avenues of mass-personalised healthcare, on the other, they raise questions around data privacy, security, inconsistency and incompleteness.

There are two perspectives on reimagining health information exchange in India: one calls for secure enabling technology, while the other calls for standardisation through regulation. For the former, India needs to look at global trends and evaluate emerging technologies such as blockchain. In the latter case, enabling standardised and secure health information exchange between healthcare providers and adjacent industries such as healthcare, insurance and pharma is an important task for the regulator. With the Indian government having framed policies and standards on EHRs, the first steps in this direction have been taken.

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Executive summary

The workflows of healthcare organisations are complex, interdependent and data intensive, with information being generated by the various stakeholders, including patients, payers and providers. Technology has helped the healthcare ecosystem to optimise these complex workflows by connecting the various stakeholders and providing real-time information that helps in delivering enhanced patient care. Historically, the Indian healthcare industry has been slow to adopt technology. Thus, the ecosystem comprises disjointed information systems that lack trust, data security, standardisation and interoperability, all of which are imperative for seamless health information exchange. The Indian healthcare industry is currently on the cusp of a transition with the launch of the ambitious Ayushman Bharat Yojana and its aim to achieve the World Health Organization's (WHO) goal of Universal Health Coverage (UHC) by 2022. In order to provide quality care to the scheme's beneficiaries, the country needs to leverage reliable technology that can help in accessing health information captured across various healthcare providers and improving areas such as tracking and detecting frauds in the payer management cycle and drug supply chain. Large-scale national healthcare initiatives would need a technology solution that encourages active participation of all stakeholders in order to generate and exchange meaningful health information in a secure and timely manner. The National Health Policy (NHP), 2017, has identified the goals for health information management, such as building a district-level health system information database, and establishing a federated integrated health information architecture, health information exchange and national health information network by 2025.[1]

Blockchain is an emerging technology that can help organisations across various industries, including healthcare, to redefine the framework for information generation and exchange. It offers the potential to transform some of the key areas of healthcare by increasing interoperability and process optimisation, and maintaining the overall security and privacy of data by increasing trust among stakeholders. Globally, healthcare organisations have started reaping the benefits of blockchain technology in terms of its various applications, such as in health data management, health information exchange, provider credentialing and accreditation, and pharmaceutical supply chain management. The Indian healthcare industry is slowly catching up.

Adoption of blockchain technology by the Indian healthcare industry will happen over a period of time as the effectiveness and sustainability of each use case are currently under research and development. At the same time, healthcare organisations need to undertake the necessary planning activities before entering into blockchain-based partnerships and programmes. As major transformations begin with small steps, this paper begins by exploring the current state of health data management and information exchange in India. It then introduces the concept of blockchain technology and how it can be leveraged to establish a well-connected healthcare ecosystem through health information exchange. Next, it explores the current challenges and key success factors for the adoption of blockchain in the Indian healthcare ecosystem. The paper concludes with our insights and recommendations on how blockchain can be adopted by the Indian healthcare ecosystem.

1. Ministry of Health and Family Welfare, Government of India. (2017). National Health Policy 2017. Retrieved from https://mohfw.gov.in/sites/default/files/9147562941489753121.pdf

01

Current state of health information exchange in India

The Indian healthcare ecosystem consists of seven key stakeholders – patient, provider, payer, pharma, medical technology, technology vendors and suppliers, and the government and healthcare regulator. These stakeholders interact with each other through a complex network of interdependent and data-intensive workflows to generate meaningful health information. Technology has helped the healthcare ecosystem to optimise these complex workflows by connecting the various stakeholders and providing real-time information to deliver enhanced patient care. As a result, the entire ecosystem moved from manual to digital media for the capture and storage of health information (e.g. medical records). Further, various platforms such as telemedicine and mobile health applications were developed to enhance connectivity between its stakeholders. The industry is currently transitioning from a manual to a digital care model which allows remote monitoring.

India has begun its journey towards achieving UHC by 2022 and has aligned NHP 2017 with this goal. The ambitious Pradhan Mantri Jan Aarogya Yojana (PMJAY), which was launched during Union Budget 2018–19, is a part of NHP 2017. It envisages two key components – establishing Health and Wellness Centres (HWCs) and a national health insurance programme under the National Health Protection Scheme, recently renamed as Pradhan Mantri Rashtriya Swasthya Suraksha Mission (PMRSSM).[2] UHC aims to increase access to quality healthcare services at an affordable cost for all people,[3] while the PMRSSM aims to increase accessibility, availability and affordability of primary, secondary, and tertiary care health services in India.[4] National healthcare

initiatives of this scale would need a technology solution that enables all stakeholders to generate and exchange meaningful health information in a secure and timely manner. Implementation of PMJAY and attaining the goal of UHC will require technology that links together the various HWCs spread across the country. Technology will also serve as the backbone for building a national-level IT platform and facilitating beneficiary identification, strategic purchase of care services, disbursal of provider payments, fraud detection and monitoring of the scheme.[5] NHP 2017 has identified the goals for health information management, such as ensuring a district-level health system information database and establishing federated integrated health information architecture, health information exchange and developing a national health information network by 2025.[6]

2. Lahariya, C. (June 2018). 'Ayushman Bharat' Program and Universal Health Coverage in India. Indian Pediatrics, 55:495-506. Retrieved from https://www.indianpediatrics.net/june2018/june-495-506.htm

3 World Health Organization. (24 January 2019). Universal health coverage (UHC). Retrieved from https://www.who.int/news-room/fact-sheets/detail/universal-health-coverage-(uhc)

4 Lahariya, C. (June 2018). 'Ayushman Bharat' Program and Universal Health Coverage in India. Indian Pediatrics, 55:495-506. Retrieved from https://www.indianpediatrics.net/june2018/june-495-506.

5 Ibid.

6 Ministry of Health and Family Welfare, Government of India. (2017). National Health Policy 2017. Retrieved from https://mohfw.gov.in/sites/default/files/9147562941489753121.pdf

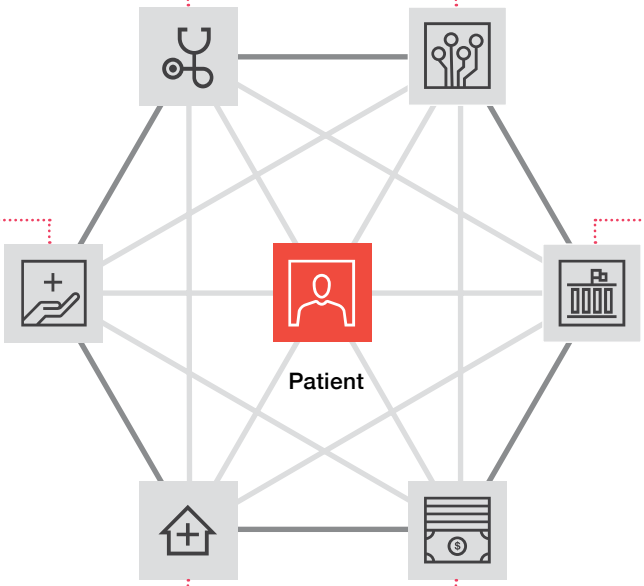
Indian healthcare ecosystem and its stakeholders

Medical technology

- Medical devices and equipment
- Diagnostics

Technology vendors and suppliers

- Electronic medical records
- Hospital information system
- Lab information system



Pharma

- Pharma manufactures
- Pharma suppliers
- Retail pharmacy

Government and healthcare regulator

- Ministry of Health and Family Welfare
- National Digital Health Authority

Provider

- Hospitals
- Healthcare centres
- Specialist clinics
- AYUSH clinics
- Diagnostic labs

Payer

- Private health insurance
- Social health insurance
- Employee health insurance
- Third-party administrator

The use of technology to tackle the anticipated rise in healthcare information generation and exchange poses several challenges related to data identification, security, privacy, accessibility, and reliability.

Key data-related challenges in the Indian healthcare ecosystem

01 Patient identification

A key challenge is the unique identification of patients across the healthcare journey. Each care provider in India uses different combinations of patient identification, making the entire process of unique identity inefficient and futile. NHP 2017 suggests exploring the use of Aadhaar for unique health identification for basic health services in the country.[7] However, in the current technology landscape, identifying a patient with a Universal Health Identification (UHID) number across India is a challenge.

02 Scattered and disjointed data

Meaningful health information comprises of two parts – patient identification information, which is captured from patient demographics, and the patient's health information. At the provider level, both of these are scattered across different departments and information systems, making it difficult to access and analyse collectively.

Also, current health information systems operate in a disconnected fashion and there is no formal connection among the various healthcare stakeholders (e.g. payer and provider) for information exchange.

03 Data ownership and duplication

Currently, patients don't have ownership of their medical records, as the care provider retains control over patient data and is reluctant to share it with any other care provider in the healthcare ecosystem. This leads to duplication of health data being generated for the same patient as s/he moves from one provider to another.

04 Role of third party

The Indian healthcare ecosystem has relied on various third-party intermediaries (e.g. third-party administrators or TPAs) for health insurance claims and processing. These third parties add to the complexity, time and overall cost of healthcare.

05 Data security and privacy

Provider-driven localised control of health data and existing technology platforms for data sharing have rendered healthcare data prone to various forms of cyberattacks, data trespassing and data security breaches. In 2018, an Indian hospital was targeted by a ransomware attack that locked out users and prevented them from accessing their data. The virus spread before it could be detected and contained.

06 Data exchange

Lack of unified healthcare industry standards, non-interoperable information systems, and lack of health data exchange platforms make it difficult for health policy planners to collect, analyse, and exchange meaningful health information in a more secure and seamless manner.

7. Ministry of Health and Family Welfare, Government of India. (2017). National Health Policy 2017. Retrieved from https://mohfw.gov.in/sites/default/files/9147562941489753121.pdf

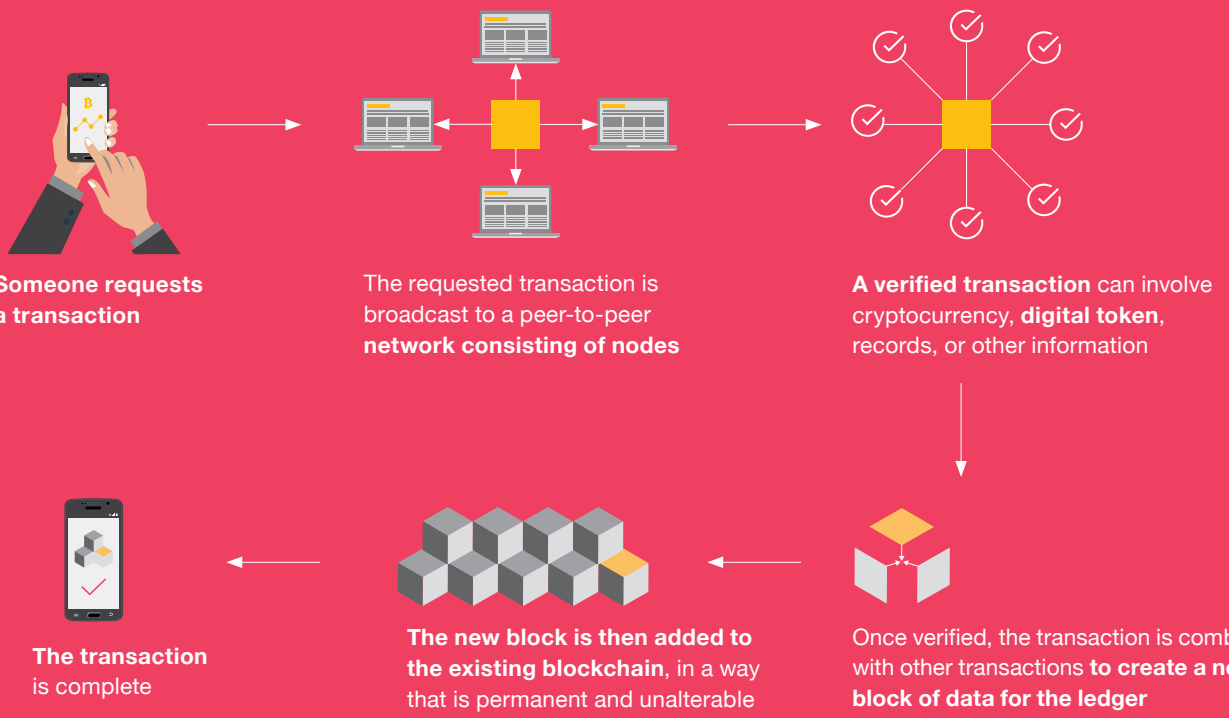
02

Blockchain: An introduction

What is blockchain?

Blockchain is a distributed, shared and immutable digital ledger that keeps a record of all transactions that take place across a peer-to-peer network. It helps to improve the overall business reach by cutting out intermediaries while offering greater transparency and traceability of the business processes.

- It is a **decentralised** (stored in multiple places) record of transactions, also known as a ledger. It is distributed among different entities (**nodes**) across a network who have access to copies of the record.
- Participants add to this **shared ledger** by recording information about transactions (information change), which are validated and accepted by users based on a **consensus**.
- Transactions are bundled together into a data **block**, which undergoes **encryption**, resulting in a unique signature for each block known as a **hash**.
- These blocks are then ordered sequentially into a **chain** of blocks, with each block containing the previous block's hash, making it **tamper proof**.
- The blocks are **immutable**, as altering a single piece of data would result in a different hash value, making the change evident to the blockchain's users and resulting in the transaction being rejected.



Source: PwC, 'How blockchain works' (http://usblogs.pwc.com/emerging-technology/a-primer-on-blockchain-infographic/)

Types of blockchain

On a broad level, blockchain is categorised as public, private and permissioned to correspond with the access control and visibility mechanisms that can be broadly assigned through its prevailing frameworks. A public blockchain is open and allows anyone to participate in the network activities; private blockchains have owner-controlled participation; and permissioned blockchains are a mix of both (public and private) with highly customised read, write and access permissions. The nature of access controls and visibility required for a specific implementation would be influenced by:

1. The business operating model
2. Stakeholders and their corresponding bargaining power in the business model
3. The end users of the application

Given this framework and the complex nature of healthcare industry's multiple stakeholder involvement, permissioned blockchains suit the healthcare industry.

How blockchain can help the healthcare ecosystem

Over the years, a provider-centred care delivery model using the current framework of existing technologies has resulted in a lack of trust and transparency in the healthcare ecosystem. This, along with issues surrounding patient data privacy, security, and the fear of losing the competitor advantage by sharing data with another provider in the healthcare ecosystem, has aggravated some of the previously mentioned data-related challenges. However, as the Indian healthcare industry now transitions to a more patient-driven care delivery model by introducing preventive healthcare and forming a close-knit ecosystem of patient-payer-provider, it is highly imperative to decentralise this model using trust-enabling technology.

With its unique selling proposition of data security, blockchain is positioned as one of the key emerging technologies that can help in establishing a trust-based healthcare ecosystem by keeping the patient at the centre of all data generation and exchange. It has the potential to redesign some of the key processes of the healthcare industry by making them secure, transparent and efficient through accountable participation by all the key stakeholders. The seamless and secure generation and exchange of data over a blockchain-enabled technology platform can help improve the overall patient experience, health outcomes, and promote further research and insights for policy planners to improve citizens' healthcare.

Across the world, blockchain has begun gaining attention as a means to ensure and improve trust, accountability, and transparency in the current complex and interdependent workflows of the healthcare industry. Some healthcare organisations have already implemented a few of the key application use cases in the areas of health data management, health information exchange, clinical trials management, tracking the pharmaceutical supply chain, health insurance claims management and healthcare provider credentialing and accreditations.

> Blockchain has the ability to transform healthcare and make it more patient centric. It has the potential to digitise the entire patient lifecycle by creating immutable records across systems and letting bona fide stakeholders use those records digitally. Along this transformation journey, blockchain also has the potential to automate and improve trust in healthcare delivery.

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Use cases of blockchain in healthcare

03

Global use cases

Globally, blockchain has gained popularity in offering solutions for health data management and health information exchange. Estonia's adoption of blockchain-based electronic health records (EHRs) is worth mentioning. When Estonia gained independence from the Soviet Union in 1991, it leveraged technology in a short period of time to empower its citizens and improve its various public sectors, including healthcare. The Estonian National Health Information System has been using blockchain-enabled e-health record solutions and a health information exchange platform. This ensures data integrity, mitigates internal data threats, and allows various public and private sector organisations exchange information in a seamless manner.[8] Functioning like a centralised, national database, the e-health record retrieves data from various providers, who may be using different systems, and presents it in a standard format via the e-patient portal. Some key statistics indicating the success of Estonia's blockchain-enabled initiatives are:

100%
electronic billing in healthcare

99%
of prescriptions are digital

99%
of health data digitised

99%
of patients have a country-wide digital record

Source: https://e-estonia.com/solutions/healthcare/e-health-record/

India use cases

The stakeholders of Indian healthcare ecosystem are currently at various stages of planning, designing, implementing, and adopting a blockchain-based solution to mitigate some of their key challenges. There is participation from both private and public healthcare systems to adopt blockchain-based solutions for enabling their EHR systems to map health information such as health summary, vitals, prescriptions and reports to the respective unique citizen ID stored on the blockchain platform. Healthcare stakeholders from the pharma and technology vendor space have formed a partnership to pilot a drug supply chain using a decentralised ledger. Similarly, efforts have been made to form a consortium to explore the various blockchain uses cases across the insurance industry.

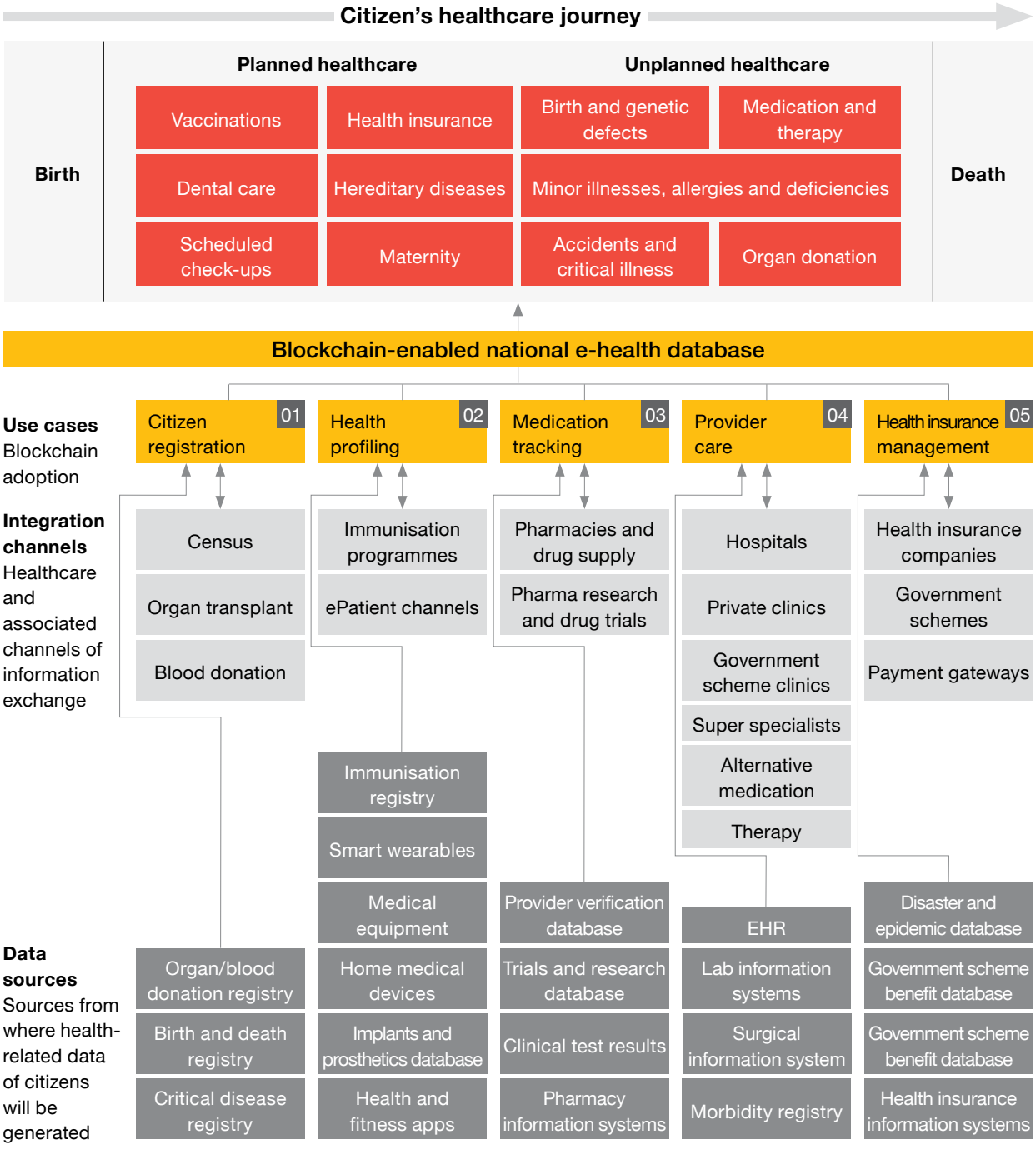
8. e-Estonia website: https://e-estonia.com/solutions/healthcare/e-health-record/

04

Reimagining health information exchange using blockchain

Key use cases of blockchain in the healthcare ecosystem

Blockchain-enabled interventions present an opportunity for making health data management and information exchange more seamless and integrated across the various stakeholders. This information exchange can be categorised under five major blockchain use cases that are part of healthcare and other associated ecosystems in India. These use cases can in turn be mapped to the different components of a patient's healthcare journey across her/his entire lifespan.



Five key use case categories of blockchain have been identified in the reimagined citizen healthcare lifecycle:

01

Citizen registration

- This covers the birth and death registration of the citizen, which can serve as the **single source of truth** for any database requiring citizen records.
- By leveraging updates from approved sources, such as the census, blockchain can form the single source of truth for citizen records, and can be integrated to provide citizen information to any other database, such as the Unique Identification Authority of India, which requires citizen information.
- Furthermore, this can be integrated with the organ and blood donation database, government health coverage schemes, etc., to create a truly interconnected system.

02

Health profiling

- This database will contain the health information of all citizens. It will have a **personalised health profile** for each citizen, which includes their vaccination chart, disease profile, lab test results, and diagnosis and hospital admission chart. These profiles will also be useful for centralised mapping of citizen dependents.
- This will also be useful to maintain a **confidential and secure** record of citizens with rare blood types and to diagnose rare diseases or epidemics and provide necessary medication and special care.
- No medical personnel or authority will be able to track a citizen's health profile without her/his permission and citizens would have the authority to view or edit this data.
- Blockchain will be most beneficial in terms of **data security** as concerns regarding unauthorised access to citizen health records will be taken care of.
- Government-accredited hospitals and laboratories would be integrated with the blockchain to add new information (e.g. lab reports approved by a citizen) to a citizen's medical profile.
- **Information control** would be established to ensure that each approved entity (validated by the government, citizen or a combination of both, as per the case) has the authority to overwrite information into the blockchain, and that the user is notified about any such update.

03

Medication tracking

- This will maintain the **drug inventory across** the pharma supply chain, linked to all pharmaceuticals, pharmacies, hospitals, clinics, etc.
- This will help **prevent counterfeit and black market** medicine sales across the ecosystem by establishing a digital system to validate seller licences, as well as help ensure these licences are not misused
- It will also ensure that the **benefits** of health schemes reach the end customer, regardless of how remote they are.
- This will be managed by mapping the citizen's **medication profile** with the various healthcare schemes availed to identify misuse of healthcare schemes at any level.
- Users with Internet access can **track** their medication and accordingly procure it at the right **prices** through **authorised** distribution methods.

04

Provider care

- This will **bring together** the entire ecosystem of providers that currently store only their own organisation-level patient data in a **single repository**. Thus, the citizen will benefit from information availability and gain an enhanced patient experience when visiting a provider.
- Citizens will be able to **view** the availability of health services in their neighbourhood based on their requirements, as well track the end-to-end patient journey during outpatient visit and hospitalisation.
- By establishing an easy-to-access and direct channel of feedback between customers and the government, it is possible to ensure that providers deliver a consistent level of **service quality**.

05

Health insurance management

- Citizens will be able to **manage** their private as well as public health insurance scheme claims and will benefit from blockchain-enabled **seamless and cashless claim processing**.
- This will ensure that the time lag in complaint resolution and manual processes involving multiple stakeholders are eliminated by facilitating cooperation among all stakeholders through a **single seamlessly integrated** system.
- Coupled with citizen records, this will also **reduce the number of false claims** by identifying the submission of repeated fraudulent claims, fake patient identities or false heath records.
- It will also ensure that **genuine claims** are always addressed and there is **timely** intervention in the case of grievances.

> Healthcare generates more data than any other industry globally. However, given concerns about both privacy and tampering, there is suboptimal use of this data. Blockchain addresses both these concerns and could revolutionise the way we use data to enhance clinical outcomes and reduce costs.

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Citizen's life journey captured on healthcare blockchain

In the reimagined blockchain-enabled health data management and information exchange platform, a citizen's healthcare journey can be mapped from birth to death across the various age groups. This blockchain-enabled national health database will capture all kinds of curative and preventive healthcare information of citizens across the various levels of care delivery models in India via the various interconnected registries. This information will help national health policy planners and regulators to enhance health systems in the race to achieve the goal of UHC.

At birth:
Birth registration captured on blockchain, will trigger initiation of the vaccination schedule

Birth registry

Infant:
On-time vaccination administration and monitoring of child growth on blockchain

Immunisation registry

Blockchain-enabled national e-health database

Morbidity registry

Mortality registry

Child:
In case of an ailment, a visit to a clinician who records complaints and other clinical details on electronic medical records (EMRs)

Youth:
Use of blockchain-enabled mobile health application to record and track personal health data

Adult:
Hospitalisation for a planned surgery, previous clinical history is tracked by the treating clinician

Middle age:
Preventive healthcare being captured for personal and employment-related annual health check-up

Geriatric:
Visit to local geriatric medicine facility for chronic disease treatment captured on EMR

Death:
Emergency hospital admission due to chronic illness, patient succumbs, cause of death captured as an International Classification of Disease (ICD) code, notification sent to health and mortality registry

Reimagining stakeholder interactions with blockchain

One of the examples of healthcare interactions from the citizen's life journey in the reimagined scenario is the hospitalisation lifecycle of a patient, where blockchain can transform some of the current processes at the provider end and enhance patient experience.

Morbidity registry

Current ecosystem	Hospitalisation process	Blockchain-enabled ecosystem
• **Manual capture** of admission record, **duplication** of episode ID • No details of previous admission at hand to assess if readmission • **No visibility** of clinical service and bed availability	Patient admission	• **Real-time** online updates of admission process details for timely preparedness and reference • **Easy availability** of previous admission at same or other care provider supports clinical decision
• **Verbal, manual and memory-based** capture of patient's clinical record • **Duplicate capture** of previous medical, family and other history	Clinical documentation	• Electronic and real-time capture of clinical details • **Quick access and retrieval** of patient's past and other medical history for clinical decision support
• **Time delay** in record of investigation results due to manual or lack of real-time connectivity between existing systems	Investigations	• Ease of **sharing, storing and remotely viewing** accurate investigation results in real time • **Secure integration** of diagnostic system with EHR
• **Manual and time-consuming process** to arrive at diagnosis due to lack of access to clinical symptomatology, investigations ordered and their results in one place	Clinical diagnosis	• **Quick and accurate** clinical diagnosis due to real-time and electronic availability of required patient clinical details and results
• **Manual** ordering and indenting of medicines • **No visibility** into medicines prescribed by other treating clinician can impact patient safety	Medication and treatment	• Electronic, on-time medication order and dispensation • Medication dosage **tracking and monitoring** • **Real-time visibility** of other medicines being prescribed ensures patient safety
• Physical patient monitoring is captured on flowsheets and other manual clinical documents • **Lack of real-time validation** by treating physician	Monitoring	• Allows **real-time and remote monitoring** of patient by care provider due to integration of medical devices to EHR
• Lack of real-time online information on patient condition leads to **lengthy and time-consuming process** as multiple approvals are needed from various departments in the hospital	Discharge	• **Real-time, remote monitoring** of patient's condition by all key stakeholder departments in the hospital leads to a faster discharge process
• **Coordination** with TPA for pre-authorisation and necessary approvals • **Manual and time consuming** claim verification at TPA	Health insurance claim	• **Automated** transmission of patient billing details • Workload at TPA **lessens** due to ease of online, real-time claim verification • Alert on previous history of claims to **detect fraud**
• **Slow and manual** reimbursement process • **Physical copy** payment receipt and its storage	Payment	• **Timely** claim verification and payment and compliance with regulatory body mandates • **Integrated insurance payouts** via digital transactions

Advantages of blockchain in the reimagined scenario

A patient-centric blockchain-based approach to improving clinical care will benefit both providers and the healthcare ecosystem and ensure that patient trust is maintained. The benefits of such a blockchain-based ecosystem can be categorised into two types: those for the provider and those for the patient.

1 Patient admission

For the provider

- **Ease of communicating** admission-related details to patients and their relatives
- Allows **easy retrieval** of past admission at same or another provider using the unique patient ID, **identifying readmission** cases
- Internal integration opportunity with hospital information system, reducing manual effort and time spent on ensuring communication between different departments
- **External integration** opportunity with stakeholders such as insurance companies and speciality labs for related services

For the patient

- Patients can **provision visibility** of the procedures scheduled and sharing of related information with their relatives and family members
- Allows **permissioned access** to past admissions, treatments, and related details for the treating provider

2 Clinical documentation

For the provider

- **Permissioned and secure access** and retrieval of patient's previous clinical records from blockchain to **support clinical decision** making and accurate diagnosis
- Allows **secure, electronic, validated, and immutable** clinical documentation by all treating clinicians on the same admission episode block, which is complete and accurate for the ICD coding

For the patient

- **Eliminates** the need to carry and maintain physical copies of clinical records
- Enhanced patient security by allowing access to various **allergies and proven drug reactions** captured on previous clinical encounter

3 Investigations

For the provider

- Secure access to previous diagnostic test results **eliminates duplication** of same investigation being ordered and helps cut cost of treatment
- In case of investigations being sent to an **outsourced lab** – real-time access to results being processed at that lab aids in quick decision making and **clinical correlation** in case of multiple investigations

For the patient

- In the case of a diabetic patient, access to all previous results of an investigation (e.g. fasting blood sugar) can help the patient **track** the progress of treatment and help **inculcate healthy** behaviour in the patient (e.g. proper diet, walking or exercise) to control diabetes and promote care coordination

4 Clinical diagnosis

For the provider

- Allows **leveraging of clinical analytics** due to availability of well-organised patient data, leading to **improvement** in clinical diagnosis accuracy and helping to **establish clinical care pathways**
- Scope for **leveraging other emerging technologies**, such as deep learning models, to automate establishing accurate clinical diagnosis
- Helps clinicians to provide **precise and accountable care** which is clinically accurate and ensures **patient safety**

For the patient

- Accurate clinical diagnosis by clinician helps in **accurate treatment protocols** which ensure speedy recovery and help **reduce the length of stay** and **need for readmission**
- Helps establish a **trusting relationship** between patient and treating clinician/provider

5 Medication and treatment

For the provider

- **Automated tracking** of medicine dosage helps **avoid drug reactions and interactions** due to timely data availability, leading to more effective medication
- Allows **secure integration** with other pharmacies and **inventory tracking**
- **Automated tracking** of implants, replacements, organ transplants and blood units
- Ease of **drug tracking** with integration of drug inventory and the patient's individual drug purchase history to synergise a solution and **curb counterfeit drug** sources
- Improved feedback statistics facilitates research across customer demographics and helps in **pharma research and drug development**

For the patient

- **Patient confidence and trust** while adapting to new medication
- **Personalised dosage tracker**, resulting in greater **adherence** to prescribed dosage and ensuring **medication compliance**

6 Monitoring

For the provider

- Allows **remote** patient monitoring by providing a formalised and common platform to **integrate** the data being captured and monitored by patient's personal health devices like fitness apps and home medical devices

For the patient

- Scope for an **enhanced technology-integrated patient experience** through integration with fitness trackers and home devices such as smart speakers for **reminders**, medical device for benefit monitoring; **allows secure and remote connection** with provider

7 Discharge

For the provider

- Completion of end-to-end digital hospitalisation cycle results in more **comprehensive** data being made available for **timely discharge process**
- Helps in **further improving** patient care statistics and helps **overall planning** of resources required in case of similar clinical presentation
- Automation of discharge process with linked blockchain database **ensures connectivity** of patient lifecycle, leading to **better information** for future healthcare

For the patient

- **Timely** discharge, ease of discharge and formalities, with more time for preparedness of patient care in this transition
- Integrated solution results in **connected healthcare ecosystem** components, such as post-hospitalisation nursing care, domiciliary patient care and rehabilitative clinical services

8 Health insurance claim

For the provider

- **Full automation and accuracy** of electronic claim filing helps in manpower optimisation as well as allows seamless tracking of claim
- **Provider satisfaction** due to seamlessly integrated process with payer ruling out the role of TPA; this helps in reducing the overall cost of delivering healthcare
- Provides **alerts for fraudulent claim** practices at the provider end

For the patient

- **Saves time and efforts** wasted on following up with TPA/payer for proving claim validity through **automated verification** of patient's digital profile
- Timely claim of government-provided benefits through a **secure, transparent and automated** channel, **monitored by regulatory body** for compliance

9 Payment

For the provider

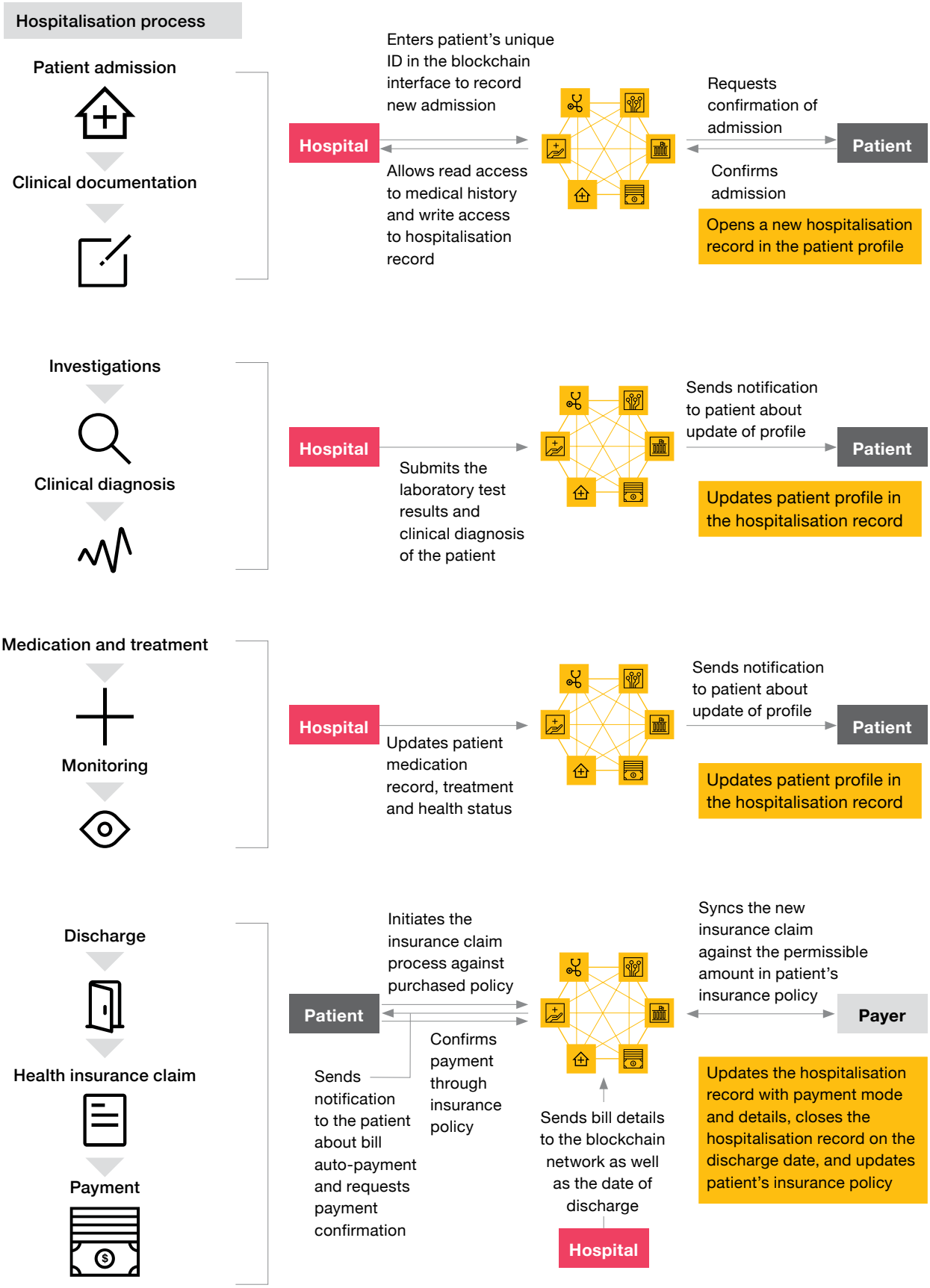
- **Integrated payment solutions**, reducing cases of customer-dependent payment, especially in managing the ethical dilemma of continuing medical care in cases of payment delays
- **Digitisation opportunity** under a unified payment gateway, regulated by the government directly to **impart trust** and **confidence** among payers and providers alike in reducing fraud

For the patient

- **Cashless transactions** and full realisation of **valid and approved** insurance benefits
- **Ease of finding** verified healthcare providers and regulated payment channels, leading to provision of quality healthcare post payment

Reimagined process enabled by the blockchain solution

In the reimagined hospitalisation scenario, blockchain will serve as the interface for a provider to edit a patient's profile directly in a secure and authorised manner after getting due permission. The new hospitalisation record will leverage the patient's medical history, as well as associated health information, such as insurance policies. The integration of medical information exchange as well as claim and payment details will make the patient journey seamless.



Technical structure of the blockchain solution in the reimagined scenario

The technical solution backing the reimagined hospitalisation process requires the collaboration of the six healthcare stakeholders that enable citizens (patients) to experience a secure and digital future.

Data read/write
Write access to specific information areas is available only to those who have a private 'key', which is provided through API

Cloud storage
Links to interface for approval rights to accept/reject sharing of profile data

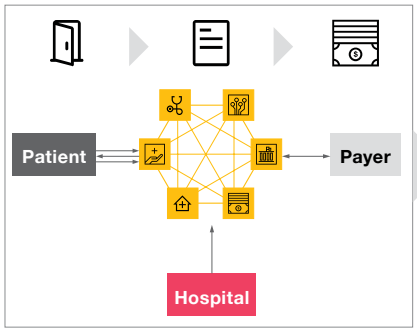
Data access permission
Represents permissions that are needed to provide the private 'key' for accessing specific information areas to authorised users via citizen or government permissions

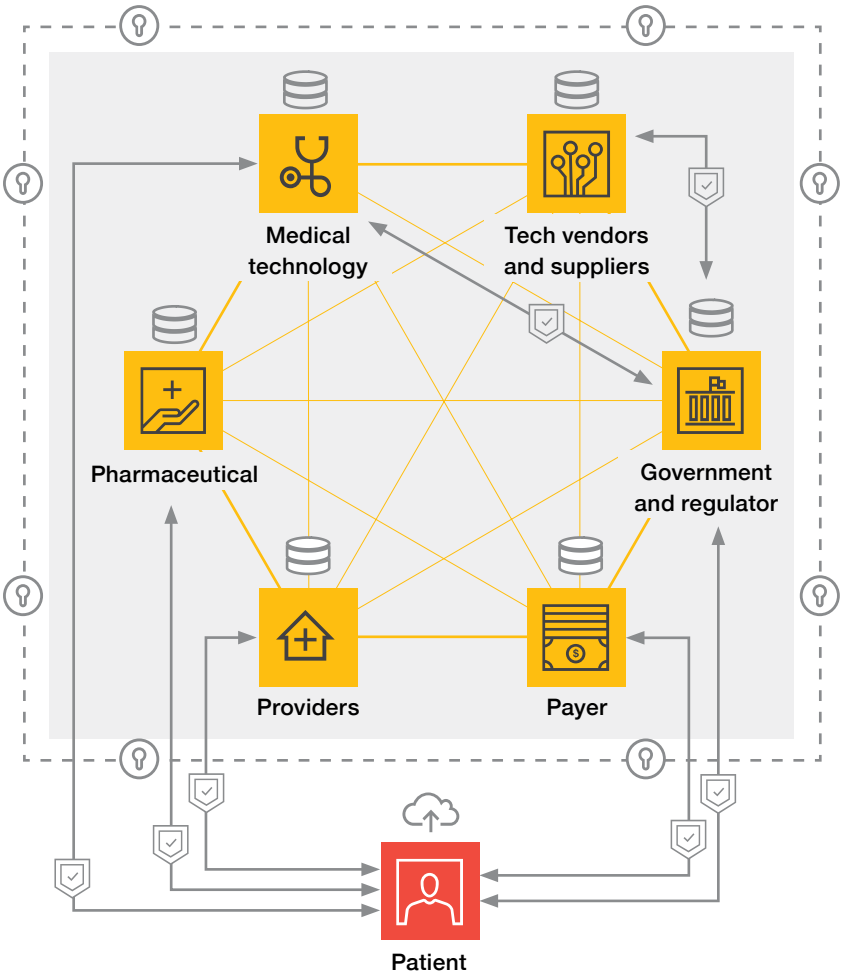
Blockchain database
Stores a copy of the encrypted health information as a blockchain node

Encryption layer
Any data to be read or written in this will require a decryption key, which is provided only to authorised parties, decided either via a validation or pre-defined as per the task

Blockchain nodes
Stakeholders who simultaneously maintain a copy of the healthcare information in encrypted format

Application programming interface (API) is a set of procedures that enable the entity invoking it to perform a set of actions, such as reading specific information or pushing data into the target structure.





05

Key considerations for blockchain adoption

The blockchain adoption checklist

As blockchain doesn't hold answers to all of the challenges impacting healthcare, we suggest that healthcare organisations evaluate the need for its adoption as a technology solution for their existing projects. If the current challenge of a healthcare organisation is addressed by any four of the following six conditions, then blockchain could be a solution.

#	Condition	Description	Healthcare relevance
1	Multiple parties share data	Multiple parties need a common view of the information being shared	In case of hospital admission, doctors from various specialties view and work on the patient's clinical data for deciding the treatment protocol
2	Multiple parties update data	The actions undertaken by multiple parties need to be recorded and updated	Discharge summary of an admitted patient for surgery is updated by various doctors like admitting doctor, surgeon and anaesthetist
3	Data verification is required	An element of trust needs to be enabled in all the parties updating and handling data for accuracy and validity	In case of emergency admission, the triage done by a nurse is further verified and validated by the treating doctor
4	Intermediaries add complexity	Transaction is dependent on third-party intermediaries which increases the cost and complexity	Role of TPA in health insurance claims management
5	Time-sensitive interactions	To ensure timely data interactions between the various parties	In case of ICU admission, timely availability of patient's vital signs is crucial for treatment
6	Multi-level transactions	Similar actions of multiple parties are crucial and interdependent	Medication administration and management in case of chronic disease treatment require details of multiple doctors prescribing medicines in order to avoid any drug interactions

Source: PwC's Global Blockchain Survey 2018

Key readiness activities

The following considerations need to be taken into account to tackle the seven potential challenges related to blockchain adoption in the healthcare ecosystem.

1 Technical readiness

Challenge

While significant developments have already been made, blockchain is still evolving. Interest from the developer community and various industries has helped to accelerate research on the technology.

While this is beneficial for the technology in the long run, the evolving ecosystem also leads to the fear that any adoption may quickly become outdated.

Consideration

- Before performing the proof of concept (POC), healthcare organisations should be updated with the latest changes.
- Blockchain should be adopted at a stage that ensures that there are no issues with adoption by patients, for which public awareness about the technology is a must.
- Technologies should be scalable for future needs and other changes.
- Planning for implementation should factor a buffer for timeline extensions.
- Organisations should take into account the transaction speed, readiness and security.

> "Adoption of blockchain technology should involve an assessment of how different stakeholders across industries/organisations can come together to develop reliable, structured and secured data exchange processes with data collection points across the lifecycle of the customer. The life insurance consortium (consisting of 14 life insurance companies who participated in the proof of concept [POC]) identified two relevant blockchain uses cases – a common new business data and fraudulent claims detection database for risk mitigation and a reusable medical record database. The key takeaway from the POCs was the prerequisite of ensuring standardisation and purity of data to be consumed."

Anand Pejawar
President, Operations, IT & International Business, SBI Life Insurance Company Limited

2 A compelling use case

Challenge

While the concept of blockchain can be applied to an abundance of use cases in the context of healthcare information exchange in India, it is important to identify practical and compelling ones that persuade providers to adopt blockchain over alternative technologies that are currently available.

Consideration

- It is necessary to understand the different types of blockchain (public, permissioned and private).
- Organisations should identify the use cases that are not just well suited to meet their goals but also aligned with the solution approach based on the expected benefits.

> Despite being early adopters of various emerging and transformational technologies, we are yet to come across a meaningful and viable use case of blockchain adoption for our services in the current ecosystem which has an impact on the clinical outcome. Even now, we ensure that our external based systems are HIPAA compliant.

Rajiv Sikka
Head of IT, Medanta

3 Tangible and intangible outcomes

Challenge

Adoption of blockchain is directly linked to the investment cost and the return on investment (ROI). Due to timeline flexibility, it is hard to pin down the exact budget for blockchain adoption, a problem that is further compounded by the evolving skillset and resourcing requirements.

Given the novelty of the technology itself, estimates on ROI may vary from those post implementation, especially for private healthcare players that need to justify the investment to their shareholders on the basis of returns.

Consideration

- The solution should quantify the perceived benefits and resourcing needs.
- The chosen solution should deliver value (in terms of either economic feasibility or other security benefits) to organisations so as to justify the investment in the technology.

In 2018, PwC conducted its Global Blockchain Survey that covered 600 executives from 15 territories to reveal insights into the current state of blockchain technology and provide a glimpse of future trends. It covered 74 healthcare companies and gathered their views on blockchain adoption in health industries.

- 49% of the respondents said their companies were developing blockchain solutions; many also said they understood they would need to work through challenges on the way to implementation.
- 61% of healthcare companies reported their blockchain projects were challenged by a lack of appropriate blockchain skills on the team.

4 Structure set-up

Challenge

A new technology either leverages an existing interconnection of processes and data flows, or necessitates changes in the processes that are impacted by its adoption.

Blockchain, at a fundamental level, aims to serve as a base for information flows, which will invariably affect the entire portfolio of the healthcare industry's processes. This change will in turn require the support of not just the existing network of vendors in India but also that of other players that may not be in the organisation's direct vendor network or competition. Nevertheless, the latter would influence the acceptance of the particular framework on which the blockchain solution is based.

This support may be difficult to ensure, not just because of the cooperation required among multiple parties but also due to the need for a consensus on the standard practice for adoption.

Consideration

- The adopting healthcare organisation should have an evolved solution landscape with multiple vendors to choose from.
- They should have a third-party system to establish a smooth network of health information flow and data exchange.

> "Blockchain is definitely the future of Indian healthcare. However, it needs an ecosystem to thrive in, which should be based on health information exchange.

J. P. Dwivedi
CIO, Rajiv Gandhi Cancer Institute and Research Centre

5 Synergy with existing stack

Challenge

A change in the underlying processes in an interconnected technology stack may raise questions about the compatibility of the existing technology stack with blockchain, especially given the new and unique nature of blockchain.

As a result, all concerned stakeholders may have to back to the drawing board in order to understand and work towards making blockchain an automated process. Anything less than a seamless experience among different technology interactions will limit the envisioned benefits of blockchain.

Consideration

- The blockchain solution should be compatible and capable of being integrated with the organisation's existing technology stack.
- It should enable smooth change management.

6 Computational feasibility

Challenge

There is a misconception that all types of blockchain require very high computational power and thus have an equally high energy footprint. While this may be true for certain methods of blockchain based on the proof of work (POW) framework, there are other types of blockchain which do not have such requirements.

Unfortunately, public perception is biased due to specific use cases that have been implemented.

Consideration

- A private or permissioned blockchain can be adopted to minimise the capacity requirement and its associated impact.
- Advertising should be used to educate the public about the different types of blockchain and the use cases they are suited to.

7 Government and healthcare regulator

Challenge

Government regulation is a vital element to any mandate. It provides credibility and enables swift technology adoption by standardising the rules and timelines to which the concerned parties must adhere.

In India, such a regulatory body in healthcare is in the process of being finalised. With security being the unique selling proposition of blockchain, a body such as the National Digital Health Authority (NDHA) has the ability to give both direction and momentum to its adoption.

Consideration

- There should be clear laws and regulations on adoption, with mandates and penalties in case of non-compliance.
- The government needs to frame a legal framework which should be imposed stringently but with a caveat that laws should be formed in a participative manner by taking into consideration industry perspective in and making allowances for geographical conditions, resource availability and a public-private partnership administration model.
- The future outlook on government regulations should be favourable.

> "Two of the focus areas for healthcare providers in India and across the globe would be to further instil trust in their patients that their health data is safe and to ensure interoperability by providing seamless access to patients' health records across providers. In both of these areas, blockchain technology will be the key. Governments and regulators are working to lay down health information exchanges for the larger benefit of their citizens and in the GCC, we expect such regulations to be in place within the next 12-18 months. Such regulations will mean that healthcare providers will have to upload patient records to the central exchange, and blockchain technology will be a key lever to enable this.

Veneeth Purushotaman
Group Chief Information Officer, Aster DM Healthcare

06

Call to action: Recommendations for the industry

Blockchain offers a variety of applications across the Indian healthcare ecosystem. The biggest advantages of blockchain are that it has the potential to make health data management and information exchange secure, transparent and trustworthy. Blockchain-based solutions offer a huge opportunity to reimagine how healthcare stakeholders generate, access, collect, consume, monitor, validate and, most importantly, exchange health data. The technology can not only open up new paths to a collaborative and interconnected future for the healthcare ecosystem (as can be seen from the use cases identified earlier) but also make data more secure from a payer perspective.

Blockchain will be introduced in the Indian healthcare industry over a period of time as the key blockchain-enabled use cases are currently being researched. In the meantime, the healthcare ecosystem should plan and design its current processes and systems to start adopting the various citizen-focused blockchain partnerships with its key stakeholders in order to ensure seamless health information exchange.

Role of provider ecosystem

- The current disconnected environment of healthcare providers that maintains localised control over patient data will need to be decentralised via blockchain to increase patients' data ownership. Various providers across the healthcare ecosystem in India will need to decide and agree on the common standards for capturing, storing and sharing health data in a secure manner, ensuring patient data privacy for seamless health information exchange.
- A major factor would be establishing the framework of healthcare information exchange for connecting all the stakeholders of the ecosystem. Healthcare providers will need the support of other stakeholders such as the health technology vendor ecosystem, as well as a government and regulatory push to establish the ideal blockchain-enabled health information exchange solution.
- The vendor ecosystem will help in designing and implementing blockchain-enabled systems and solutions. This will ensure interlinked, secure and trusted connectivity between the payer and the provider.

Role of the government and healthcare regulator

- With the NDHA taking the lead in health data regulation, the next step is to build confidence across the healthcare ecosystem by preparing it for compliance with health data regulation standards and mandates. This body should be empowered to govern the changes in the healthcare ecosystem and closely monitor the compliance of stakeholders and any potential risks of changes.
- The healthcare regulator should participate in the federated permissioned blockchain covering healthcare providers, payers and other key stakeholders of this ecosystem to help establish the envisaged decentralised network and thus ensure the authenticity of the information being generated, stored and exchanged.
- On the one hand, the government-backed regulatory push will ensure thorough monitoring and audit of the agreed standards of health information exchange; on the other, it will ensure careful monitoring of and control over health technology vendors who support healthcare providers on blockchain enablement.

To summarise, there is scope for the specialised application of blockchain in the context of healthcare information exchange in India in the form of a federated permissioned design. Such adoption will ensure active participation of all stakeholders while keeping the patient at the centre. The main question is, how soon can we expect blockchain to enable health information exchange? The realisation of blockchain's potential is dependent on both the government formulating the necessary regulations and standards and active participation from the providers in establishing the most extensive trust-based network across the ecosystem.

If the above conditions are met, a federated permissioned blockchain-enabled health information exchange model can undoubtedly play a vital role in helping India achieve the goals of UHC and the Ayushman Bharat scheme by connecting patients to the private and public healthcare systems across the country.

About BCC&I

The Bengal Chamber of Commerce and Industry, India's oldest institution of its kind, traces its origins to 1833. The Chamber has played a pioneering role as a helmsman, steering the evolution of Commerce and Industry in India. The Chamber reviewed and commented upon some of the most critical legislations in the country.

The Bengal Chamber has managed to remain both young and relevant simply because it is quick to recognize and value the only constant in time - change.

In healthcare

In keeping with this practice, the Chamber has pioneered a number of initiatives and programs in new directions in the past which have brought cutting-edge offerings in healthcare services to the common man and included lectures on health issues by leading and iconic personalities in health like doctors, entrepreneurs and policymakers. The Health Committee also organizes an annual Health Quiz, which has made a niche for itself in the corporate community of the city.

The Bengal Chamber's Health Committee has been playing an important role in addressing the critical aspects in the field of healthcare in the state and has been catalytic in bringing about significant corporate consciousness in healthcare management. It has organised health expos, panel discussions, and lectures on health issues by leading and iconic personalities in health from the fraternities of doctors, entrepreneurs and policymakers. The Chamber's National Health Debate, which has been addressed by national and international personalities, also deserves a special mention. The Committee also organizes a quiz on health and lifestyle to create awareness on healthy living. The Committee's activities also include a B2B Meet with IT companies to discuss the latest offerings relevant to the healthcare sector, a Medico Legal Workshop involving doctors, lawyers and hospital administrators to learn and share the experiences on medico-legal issues and guidelines, a Blood Donation Camp, a Seminar on Deceased Organ Donation as a gesture of our responsibility to society. The Committee also celebrates Doctor's Day in a unique way by organizing a panel Discussion and quiz with doctors.

Technology

The Chamber has a vibrant IT Committee comprising all leading developers, consultants and corporates. The focus has always been to communicate and create a bridge between technology users and developers on how applications can make enterprise planning and manufacturing processes simpler, faster and less complicated – achieving all this at a lower cost. Most importantly, as a catalyst, service provider, initiator of sector-specific activities, facilitator of business and spokesperson for the state government, the Chamber envisions itself to be the most valued partner of our members in promoting and facilitating sustainable growth.

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About Medica Synergie Group of Hospitals

Touching new heights in healthcare delivery in the east

Medica Hospitals, one of the most reputed and leading healthcare chains in eastern India today, has built and managed a number of Multispecialty and Superspecialty healthcare facilities across the region over the past few years.

Beginning its journey with Medica North Bengal Clinic (MNBC) in Siliguri in 2008, the Group launched its flagship Hospital – Medica Superspecialty Hospital (MSH) – in Kolkata in 2010. Soon after Medica Cancer Hospital in Rangapani, Siliguri, fulfilled the dire need of a comprehensive cancer facility in North Bengal, and the trust hospital R.C. Agarwal Memorial run by Medica in Tinsukia brought quality multispecialty healthcare to Assam.

Medica tied-up with Tata Steel in 2014 to run the operations of Kantilal Gandhi Memorial Hospital (an existing unit in Jharkhand) and with the Jain Samaj for Bhagwan Mahavir Medica Superspecialty Hospital (a new venture in Ranchi). Tata Steel Medica Hospital in Kalinganagar, Odisha, began operations in 2015. In 2016 Medica took over the operations of Medica Gamma Hospital (developed as a boutique healthcare unit in the heart of Kolkata). In 2017 Medica stepped into Bihar with a specialized heart care unit, Medica Heart Institute, Patna, providing comprehensive heart care services in the region. The same year and the group's Burdwan unit (multispecialty hospital) also became functional. On the anvil are healthcare units in Asansol and Gopalpur.

Medica Superspecialty Hospital, Kolkata

A unit of Medica Synergie, the Kolkata Hospital, located in Mukundapur, off EM Bypass, is today one of the most respected and trusted healthcare providers in Eastern India. Filling a huge lacuna in tertiary healthcare in the east, Medica has kept its promise of delivering quality healthcare using ethical practices in a transparent set up. Medica has revolutionized healthcare delivery in the region through not just technological advancements and innovative treatment techniques, but also in the area of patient care.

Our specialties

Medica has eight Centre of Excellence – Neurological Diseases, Cardiac Sciences, Orthopaedics, Gastroenterology & GI Surgery, Kidney Diseases, Critical Care, ENT and Breast Diseases – headed by renowned specialists and surgeons, with comprehensive treatment facilities. The Hospital also has departments of Obstetrics & Gynecology, Pediatrics, Endocrinology & Diabetes, Dermatology, Plastic Surgery, Internal Medicine & Surgery, Bariatric & Metabolic Surgery, Comprehensive Hernia Surgery, Endocrinology & Diabetes, Psychiatry & Psychology and international standard Physical Therapy & Rehab services for post-surgery and medical management of patients along with specialized services in sports injury management and counseling.

Other locations

Medica operates a 150-bed multi-specialty hospital in Jamshedpur, and a 200-bed unit in Kalinganagar (Odisha) in collaboration with Tata Steel, a 300-bed Superspecialty hospital in Ranchi (Jharkhand), two hospitals in Siliguri (including the district's only comprehensive Cancer Hospital), a specialized Heart Hospital in Patna, and a multi-specialty hospital in Tinsukia, Assam. In the international arena, the Group has presence in Bangladesh, Bhutan, Nepal and Myanmar.

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Dy Medical Superintendent, Medica Synergie

About PwC's Healthcare practice

PwC India's Healthcare team offers Advisory services in the healthcare sector covering multiple domains such as strategy, business planning, market scan, commercial due diligence, feasibility study, operations improvement, cost reduction, health IT, digital and technology, internal audit and PPPs.

The Healthcare Advisory team of over 30 members combines over 40 years of operational experience in setting up and managing hospitals, and over 120 years of healthcare consulting experience. This enables the team to deliver granular strategy and market and operational insights of the highest quality. The team works with leading healthcare providers, medical technology providers, central and state governments, diagnostic players, insurance providers and private equity players on projects both in India and overseas.

Our Social Sector Advisory Services, a division within the GRID practice, also works with several government (national and state) departments, IFIs and private players in the social sector on health and nutrition, education and skill development, livelihood, governance, local community development based in urban and rural areas, and women and child development. All these sectors and sub-sectors are multidimensional in nature and are intricately interconnected through various aspects, including grass-roots community development.

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