



Viewpoint

Role of blockchain technology in boosting *Ayushman Bharat* scheme implementation in India

In National Health Policy 2017, *Ayushman Bharat* (AB), a ground-breaking public health insurance scheme was conceptualized by the Hon'ble Prime Minister, which aims to achieve its goal of Universal Health Coverage (UHC) and a mission statement - Health for all by 2020.

Taking a holistic approach to health, AB addresses primary, secondary and tertiary health care (including prevention and promotion). As part of its continuum of care approach, AB integrates two interconnected components (a) Health and Wellness Centers (HWCs) to strengthen and comprehensively deliver Primary Health Care (cPHC) services to the population at large and; (b) *Pradhan Mantri Jan Arogya Yojana* (PMJAY) scheme for hospitalization services (both secondary and tertiary level) for bottom 40 per cent of families in India¹.

There has been a lot of discussion regarding AB's limitations (Claim Frauds, Low package price, weak hospital empanelling criteria, out-of-pocket expenditure of beneficiaries, monetary sustainability of the scheme). However, there are also potential solutions that may be discussed to improve the viability of the programme or any publicly funded health services². IT solutions have helped fuel the growth of Indian healthcare with the advent of IoT (Internet of Things)-driven smart medical devices, personal healthcare apps, telemedicine, artificial intelligence for clinical decision making, online pharmacies for convenience, and price comparisons. An integral part of the discussion often omits the possibility of transportable or intraoperative Electronic Medical Records (EMRs) which primarily serve as a platform for creating a patient bill. Due to this, most patients pay *a la carte* for the services they consume (doctor's time, drugs, radiology reports, procedure, *etc.*)^{3,4}. Clinical guidance can also be provided by more advanced electronic medical records, wherein patient's electronic and organized file travel with them to their village Primary health center (Health & Wellness Center), which further should

improve the quality of care and ensure they receive proper follow up. As a result, the Government of India (GoI) would be able to track and pay for clinical outcomes, thereby improving cost containment and quality assurance. The success of any Government-funded scheme depends on the optimum utilization of funds and avoiding any wasteful expenditure. The optimum utilization of resources may be seen while development or upgradation of AB-HWCs. Installation of Solar Panels for electricity may be seen as one of the cost effective utilization of funds^{5,6}.

Similarly, establishment of checks and balances to contain costs or stop unnecessary services will optimize the fund utilization. Blockchain technology, which is receiving a lot of attention, might be used to facilitate a national medical record system and serve as the foundation for a centralized, robust medical record system. A blockchain-based EMR system generates a confidential access code that is only available to the patient ensuring data integrity^{7,8}.

The blockchain technology

A new technology has emerged that can be attributed to cryptography and other theories that can provide transparency, immutability, decentralization, and consensus⁹. Several application domains, such as crypto currency (Bitcoin, Litecoin, Namecoin *etc.*) and decentralized applications (DApps), have demonstrated that block chain can be a fundamental technology¹⁰.

A block chain is a record of a peer-to-peer transaction made by linked immutable transaction blocks and shared in a network. Every node of the network has a copy of the distribution ledger, which is a type of database which is shared, replicated, and synchronized within a network. The distribution ledger records the transaction of data among the network¹¹. As a result of Block chain technology, information ownership and integrity can be verified without relying on a single central

agency. Aside from that, it facilitates the exchange and transaction of digital assets while providing a secure environment that allows for a more relaxing exchange of data and unwavering contracts between parties¹². Researchers are currently discussing four types of block chain namely public, private, hybrid, and consortium. By allowing participants to set their own privileges, a block chain with permission falls somewhere between a public block chain and a remote block chain.

Blockchain are essentially data structures that are used to link multiple blocks of transactions securely by virtue of each block's signature, which is determined by its content and the signature of its predecessor.

In addition, if an intruder or hacker attempts to modify one block's content, all subsequent blocks' signatures are altered as well. When implemented in a centralized system, this cascading phenomenon is unusable. In spite of this, the method is revolutionary when implemented in a decentralized manner using a large number of computers (nodes). Essentially, block chains are decentralized systems in which blocks of transactions are securely linked to each other, and the same block chain is replicated across numerous computers. It is automatic for a node to correct its block chain after a period of time when it is attacked by an attacker who attempts to attack a block.

Blockchain in healthcare

In healthcare applications, permissioned blockchain's are popular due to the need for diverse stakeholders to have varying privileges and access levels to patient data. Among the healthcare activities that can be motivated by blockchain technology are clinical trials, drug authentication, data exchange regarding health, and health insurance. Using smart contracts¹³, a blockchain technology enhancement, may enhance the security of health data and the welfare of people and the social order in the healthcare sector.

The effective use of Blockchain Technology in healthcare could be seen in COVID-19 vaccination programme (Co-WIN). This platform facilitated the registration and scheduling of vaccination appointments, vaccination coverage tracking and monitoring adverse events¹⁴.

Among the notable advantages of blockchain technology in healthcare is its inherent immutability.

There are instances where healthcare providers are hesitant to share patient information with other healthcare providers out of concern about their data privacy or

competitive threats. This can be addressed by establishing a national healthcare blockchain for Indian citizens. In this seamless healthcare data exchange, patients are at the centre and everyone involved in the healthcare process is held accountable, as well as transactions are transparent, making it possible to formulate innovative policies and deliver high-quality healthcare services. In addition to improving access to prescription databases, medical records, hospital assets and device tracking block chain technology can restructure the interoperability of healthcare databases. Among the most significant benefits of utilizing blockchain technology in healthcare is the ability to track the entire life cycle of devices within the block chain infrastructure.

By eliminating errors, automating processes, and preventing fraud, blockchain can significantly reduce healthcare costs by: (i) *Reduced administrative costs*: Automation frees up staff time, allowing them to focus on patient care instead of paperwork; (ii) *Faster claim processing*: Quicker claim settlements improve cash flow for hospitals and reduce administrative costs for insurers; (iii) *Lower fraud costs*: Blockchain's inherent security significantly reduces the risk of fraudulent claims, saving both hospitals and insurance companies; (iv) *Efficient Billing*: Blockchain offers secure, shared, efficient & error free ledger of all billing transactions¹⁵.

By storing quality-related data on the blockchain, hospitals can foster transparency and accountability, improve quality assurance by ensuring, (i) *Patient-centric data*: Patients own and control their medical data on the blockchain, ensuring its accuracy and accessibility; (ii) *Performance measurement*: Quality metrics based on patient outcomes and feedback are stored on the blockchain, allowing for comparisons between hospitals; (iii) *Continuous improvement*: Easy access to quality data enables hospitals to identify areas for improvement and implement data-driven solutions.

The roadmap to blockchain in healthcare is well planned, wherein short term, minimal or no patient data will be handled except for few pilot projects. Progressing to medium term, the number of stakeholders and scalability will increase, with permission, handling of patient data. While in long term, a patient driven system will be established, where patients will have access to their master health records¹⁶.

Blockchain application in Ayushman Bharat scheme: Universal health coverage cannot be realized without State-sponsored health insurance schemes. Technology plays an important role in making decisions and

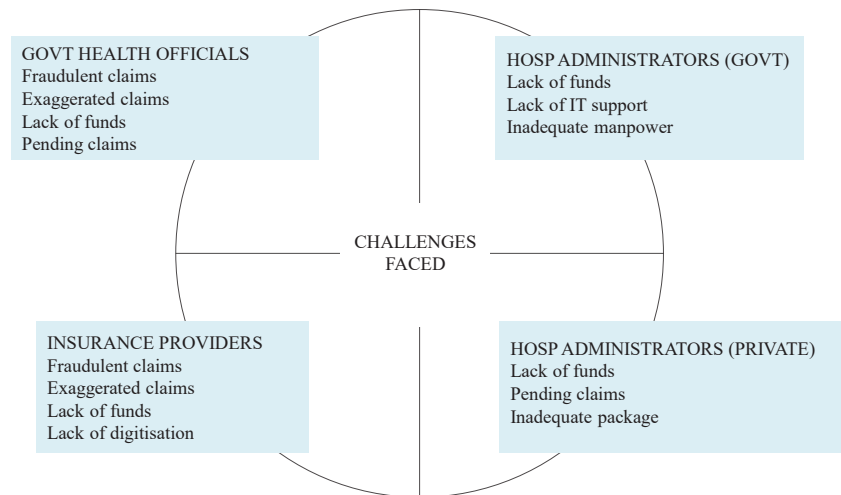


Figure. Challenges faced by different stakeholders under *Ayushman Bharat* scheme. Hosp, hospital; Govt, government; IT, information technology.

setting priorities in relation to the implementation of the same^{17,18}.

It has been half a decade since India has experienced a data revolution, mobile internet has infiltrated zones where even electricity is still unavailable regardless of one's economic status¹⁹⁻²². The Government of India under the mission of digital India has also included broadband for all rural, e-Kranti services which can overcome the poor digital literacy among PMJAY beneficiaries^{23,24}. With almost 65 per cent mobile usage penetration in our country, there is a strong need to develop a mobile app based EMR system which is user friendly and at the same time has strong security lock system to avoid pilferage of data. In this case scenario, blockchain technology based EMR system will perfectly fit the requirement²⁵.

Blockchain technology can be applied through the Universal Immunization programme (UIP) under *Ayushman Bharat* scheme. Based on the same concept as Co-WIN, U-WIN (universal immunization) is established as a comprehensive digital system aligned with the *Ayushman Bharat* Digital Mission. This connects key components such as the Healthcare Professional Registry, Healthcare Facility Registry and *Ayushman Bharat* Health Account (ABHA)¹⁶.

In research laboratory, blockchain creates a safe, regionalized structure for laboratory-related data, which takes place only with blockchain, and it allows for secure sharing of that information among researchers.

With the help of blockchain precise tracking of pharmaceuticals can be done ensuring monitoring of every phase of the pharmaceutical supply chain to prevent the replacement of any goods or malpractices³.

The various challenges faced by different stakeholders of the *Ayushman Bharat* scheme^{26,27} are primarily fraudulent claims and enrolment and transparency of electronic medical records (Figure). Most of the above issues of claims can be sorted by blockchain applications for maintaining Electronic Health Records (EHR). It is only blockchain technology that allows for secure and transparent transactions.

User roles

In a blockchain-based EMR system, various participants interact with the network, each playing a distinct role:

Patients: Own and control their medical data, granting access to authorized providers.

Healthcare providers: Access and update patient data based on their assigned permissions.

Auditors: Verify the integrity and authenticity of the EMR ledger.

Network operators: Maintain the infrastructure and ensure the smooth operation of the network.

The Power of consensus: Ensuring data integrity

For a blockchain network to function effectively, all nodes must agree on the validity of the data. This is achieved through a consensus mechanism, a set of rules that govern how new blocks are added to the ledger. Nodes validate transactions based on their stake in the network (proof of stake), eliminating the computational overhead of PoW (proof of work).

Challenges in blockchain implementation

Implementing blockchain in India's healthcare system presents with possible drawbacks and limitations like scalability, interoperability and legal compliance^{28,29}.

However, these limitations can be exceeded by focusing on specific pilot projects with defined goals before scaling nationwide, collaborating with stakeholders to define interoperable data formats and standardized protocols for seamless integration with existing system, utilizing hybrid blockchains and improved scalability compared to public blockchains^{15,30,31}.

Legal issues can be addressed by engaging with policymakers to create regulations that encourage innovation while addressing privacy and security concerns, implementing robust encryption and access control mechanisms to comply with existing data protection laws.

National Health Authority (NHA) is working cohesively with Ministry of Health & Family Welfare (MoHFW) (<https://nha.gov.in>) as well as Ministry of Electronics & Information Technology to develop *Ayushman Bharat* Digital Mission (ABDM) (<https://abdm.gov.in>). The main aim ABDM is to develop the essential backbone for supporting the integrated digital health infrastructure of the country. Furthermore, it also aims at bridging the existing gap between the different stakeholders of healthcare ecosystem through building digital highways. GoI has engaged with different partners, both public as well as private to foster integration of digital platforms in healthcare with ABDM application programming interface (APIs). This partnership will help to bridge the existing gap among different stakeholders of healthcare ecosystem²³⁻²⁴.

To start with Government based organization (C-DAC: Centre for development of Advanced Computing) has been tasked to work on the blockchain based app for *Ayushman Bharat*, which will not only promote the 'make in India' vision of the government but will also help to limit the cost and breach of data to foreign concerns. The cost of this project can be recovered from the various stakeholders as well as beneficiaries over a period of time, without adding an extra visible burden on them.

Overall, it can be concluded that blockchain implementation in the Indian healthcare system can be categorized into three tiers. Tier-I consists of patients and physicians, tier-II consists of healthcare

organizations, and tier-III consists of the government. Blockchain EMR systems offer a number of benefits, including improved patient outcomes, greater transparency, digital payments and prevention of payment frauds, streamlining of pharmaceutical chain and a better research potential. Hence, integration of blockchain technology in the *Ayushman Bharat* scheme in India will definitely help in its better implementation and success.

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