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## White Paper

# Blockchain: A Healthcare Industry View



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# 1 Synopsis

The healthcare industry is under extreme pressure to both regulate costs and to provide high quality to patients. As the industry evolves alongside emergent market-disruptive technologies, it becomes increasingly difficult for businesses to keep costs down while remaining competitive.

Numerous federal regulations are adding to industry pressure. Government mandates such as health insurance marketplaces, Medicaid expansion, health information exchange (HIE), Meaningful Use and the Medical Loss Ratio are working to ensure that effective patient care becomes the focus of healthcare delivery—with all suppliers and providers in compliance.

This shift in focus has required participating healthcare businesses to continuously look for opportunities to reduce costs while enhancing the quality of care that patients receive. Keeping up with these market changes would not be possible without the technological advancements that support the healthcare industry.

This paper discusses the evolution of blockchain technology and how its application can produce a breakthrough in the healthcare industry; more specifically, the benefits it can bring to case management and member health management.

Blockchain has the potential to alleviate one of the major challenges of the industry: the transmission of patient data across geographies without compromising its privacy and security. This application of blockchain can have a major, positive impact on member health management and also provide a critical link in the support of medical tourism.



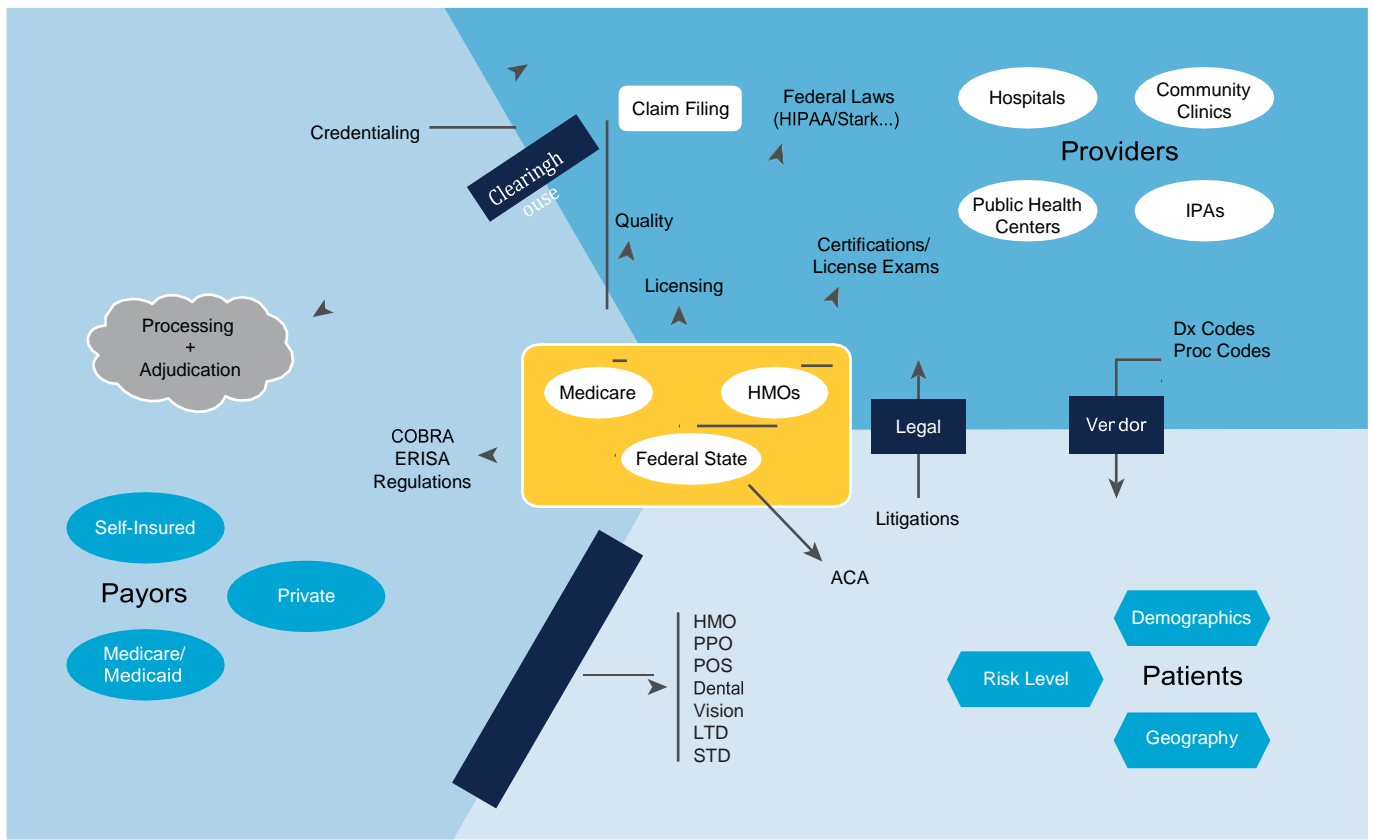
## 2 Healthcare Industry: Current State



The healthcare industry is a complex system of interconnected entities, especially in United States. Exhibit 1 illustrates just how complex healthcare delivery, financing and industry regulations can be, given the number of participants now involved in care-services delivery and administration.

This transformation of healthcare delivery has led to the evolution of the concept of “patient-centricity,” or a participatory approach to healthcare delivery. Every healthcare-industry organization, irrespective of it being a payer or a provider, understands that the only way to keep itself in contention is to provide its members with a best-of-class experience in care delivery and to keep costs low. The best-of-class experience can happen only when patients are involved in every aspect of their care-services delivery.

**Exhibit 1: A Map of Stakeholders and Interactions in the Healthcare Ecosystem**

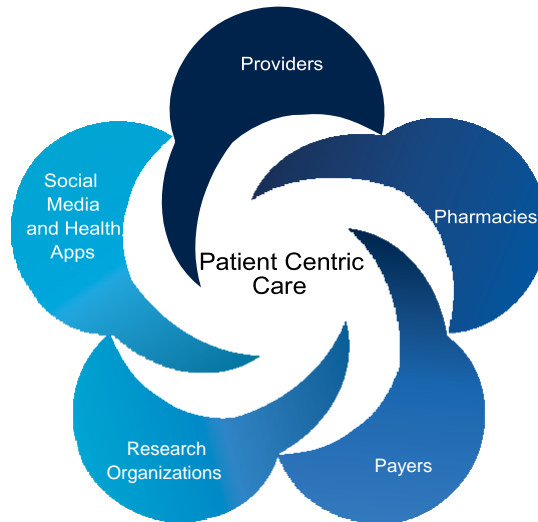


Source: Based on Yuan, Lin and McDonnel



The traditional view of patient centricity puts the patient at the center of the wheel of care-services delivery, but the decision-making is based on the expertise of the various entities depicted as the spokes of this wheel (see Exhibit 2). While patient care is the center of attention for all organizations, the decisions affecting care-service delivery and the related data are still controlled by the providers and payers.

### Exhibit 2: Traditional Representation of Patient-Centric Care



The current view of patient centricity is a scenario where members are more informed and have a higher involvement in the care that is delivered to them. This would change the equation for providers, expanding their role beyond just a “source of expertise” to become true care-coordinators—helping members interpret the plethora of data and information and, at the same time, also providing the best possible care.

Patient centricity in conjunction with coordinated care has great potential to reduce the cost of healthcare delivery while improving quality of care. However, this is only possible when a patient’s data is readily available to all the entities participating in that patient’s care.

The global availability of patient data poses numerous challenges. In order to meet all the mandates and laws defined for the security, privacy and access of clinical and personal data, organizations have invested millions of dollars in enhancements to health-information systems. However, due to the ever-changing and growing requirements from various industry and government constituencies, a solution that is secure, robust and seamless—integrating the multitude of participating organizations across geographies—has yet to materialize.

Until now, solution designers have focused on creating a centralized repository to hold and transmit member/patient data. What if we shifted the focus from a centralized data repository to a distributed, personalized storage model? What if—rather than the organization holding and providing access to a member’s data—the member/patient controls and authorizes their data? Blockchain technology can provide the foundation for this distributed, personalized, data-storage solution.





# 3 Healthcare – How does Blockchain fit?

## What is Blockchain?

Blockchain is a distributed-transaction technology that is open but secure, and public but—at the same time—private. How can this be?

Blockchain is based on a unique concept: an “append only” open ledger where every transaction that occurs within the network is added to this ledger once authenticated by the nodes in the network. It works on 3 major principles:

- The transaction is open on the network
- The ledger is distributed to ensure there is always a copy of the ledger
- Every new transaction needs to be authenticated to be added to the chain

*For a more detailed description of how blockchain works, see the Appendix.*

Growing demand for healthcare services and integrated-care delivery, coupled with increased focus on member-health management, accentuates the need for an information technology system that can remove dependency on middlemen. Blockchain can help overcome most, if not all, of these challenges. A system built on distributed architecture, blockchain doesn't require multiple levels of authentication and—at the same time—gives complete, on-demand access to chronologically-arranged data. It is a robust technology that can drive healthcare industry performance, improve quality of care and lower the cost of delivery.

Exhibit 3 presents common challenges faced by healthcare organizations and how blockchain applications can answer these challenges.

**Exhibit 3: Blockchain Answers for Common Industry Challenges**

Healthcare Industry Challenge	Blockchain Opportunities
Fragmented Data	<ul style="list-style-type: none"> <li>• Decentralized storage using computer networks for patient data</li> <li>• Shared data across the network and nodes</li> <li>• Decentralized source of Internet of Things (IoT) data</li> </ul>
Timely Access to Patient Data	<ul style="list-style-type: none"> <li>• Distributed, secure access to patient health data across the distributed ledger</li> <li>• Shared data enables real-time updates across the networks</li> </ul>
System Interoperability	<ul style="list-style-type: none"> <li>• Decentralized Internet and computer networks across geographies</li> <li>• Enables authenticity (system authentication)</li> </ul>
Data Security	<ul style="list-style-type: none"> <li>• Digitizing data security of transactions – digital identity protects patient privacy</li> </ul>
Patient Generated Data	<ul style="list-style-type: none"> <li>• Data from wearable devices (IoT) aggregated to provide holistic patient care</li> </ul>
Access and Data Inconsistency	<ul style="list-style-type: none"> <li>• Smart Contracts create a consistent and rule-based method for accessing and analyzing patient data that can be permissioned to selected health organizations</li> </ul>
Cost Effectiveness	<ul style="list-style-type: none"> <li>• Reduced transaction costs and real-time processing to make the system more efficient</li> <li>• Elimination of third-party applications removes time lag in data access</li> </ul>



One of the most important aspects of a healthcare system is the way its data is shared across entities in the value chain. Blockchain supports seamless information sharing that can eliminate the duplication, errors and inconsistencies that can arise with traditional, centralized data storage. The smart contracts application eliminates the need for intermediaries to manage and execute the member/patient contracts.

When patients with chronic conditions initiate treatment via a primary care provider (PCP) in a specialized Integrated Practice Unit (IPU), they are exposed to a variety of services such as diet planning, exercise recommendation, medication adjustment, etc. Some of these services are supported by social apps that provide the patient with instructions, reinforcements and detailed reports from the physicians and nurses (Subject Matter Experts--SMEs) related to their respective specialties. The patients can also get regular feedback and analytics using self-monitoring or home-care monitoring tools.

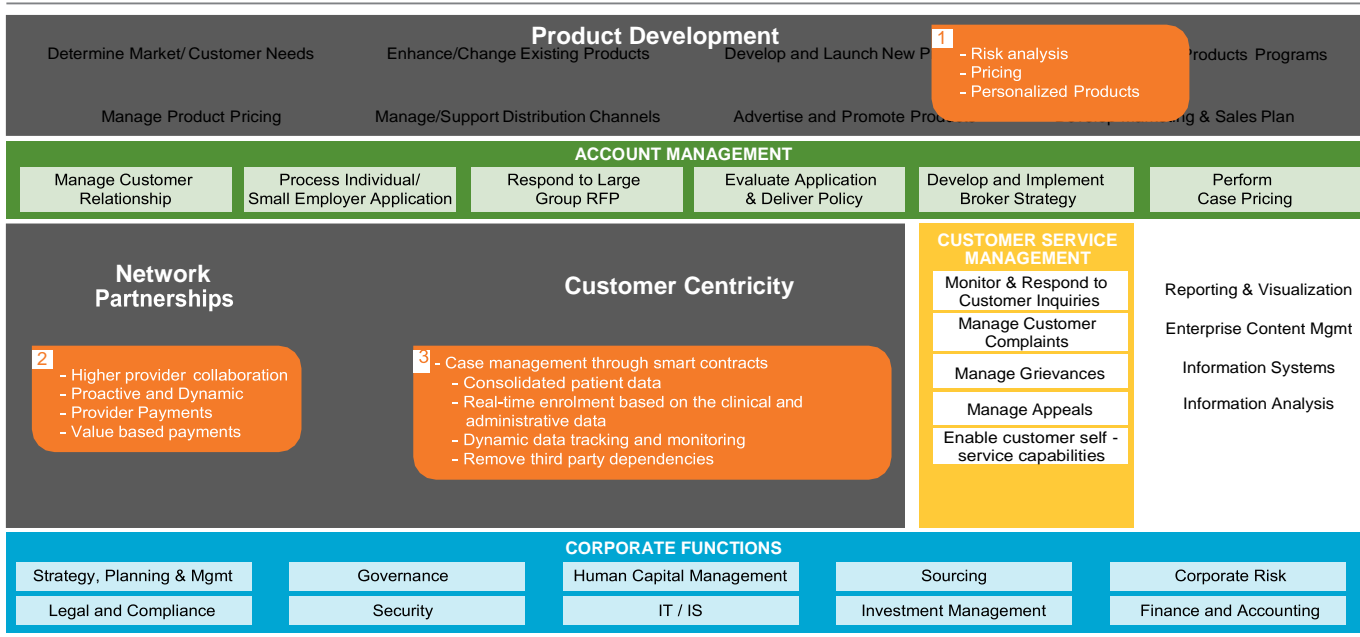




# 4 Where Blockchain can Help

While blockchain has the potential to impact all the capabilities in a healthcare organization, Exhibit 4 below highlights the impacts relevant to member health management operations.

**Exhibit 4: Potential Impact of Blockchain on Provider Operations**



Conceptually, blockchain applications can benefit the healthcare ecosystem as a whole. The elimination of third-party entities and middlemen would reduce administrative costs and increase efficiencies in claims' processing and go-to-market strategies. The distributed ledger and built-in authentication controls lower the risk of data theft and fraud. This would foster higher levels of trust in electronic transactions, which would spur electronic payments and thereby reduce payment (accounts receivable) timelines.



As blockchain-technology adoption expands, the industry will need to adapt to changing care-delivery and financial models. New smart contracts and distributed ledger applications will redefine the way products are sold, administered and, ultimately, how claims will be paid.

A major source of pain in the industry today is the amount of time it takes for claims to be settled and the determination/tracking of any member/patient co-payment/deductibles. Currently, an electronic claim can take anywhere from seven to 14 days to process for payment and paper claims can take from four to eight weeks. Given that money can now be transferred between bank accounts in just seconds, seven to 14 days to receive payment for an electronic claim appears to be excessive, reflecting an outdated process.



Conceptually, a healthcare smart-contract application could help payers reduce the time needed for claims processing and payment from seven to 14 days to as little as seven to 14 minutes. The smart contract would contain the detailed logic that represents the payer-provider contract terms and, as soon as the claim is submitted, the claim is processed in real-time and payment is subsequently transmitted to the provider. This automated process improves efficiency since, for example, the cost estimator will not only estimate the payments but also immediately approve the provider payment.

The transparency and autonomy that blockchain technology provides can lead to disruptions in the way the business is conducted. Since contract conditions and terms are captured in smart contracts and the care-delivery data is available on-demand, providers will have greater—yet still regulated—access to patient data and therefore will need to accept greater accountability for outcomes of the clinical services and products they provide to the patients.

#### 4.1. Blockchain for member health management: an example

To understand in detail how blockchain can be effective in the member health management sector of the industry, let us consider the case of a patient with a chronic disease whose healthcare is being managed by a care coordinator. The care coordinator identifies the treatment methodology and wellness goals, and then creates a time-bound, milestone-based, health-appraisal plan for the patient to follow.



A smart contract is subsequently created by the provider that contains the business rules and contractual clauses associated with the patient's health-appraisal plan. The smart contract also contains contractual terms and conditions and the legalities of the contract document. This "electronic contract" enables the automation of the administrative tasks related to processing the patient's benefits and specifying the payment terms and conditions. These contracts can also define the type and quantity of data to be collected, as well as how that data can be used for the patient's well-being.

With this smart-contract file on a blockchain network, the provider does not need to call into the insurance company for every appointment or log in to a portal in order to validate the patient's eligibility. The eligibility can be determined and confirmed real-time via the smart contract.

The data generated from the authenticated interaction points—i.e. the data related to the delivery of the contract-specified services and/or products—is collected and added as a part of the blockchain (into the open ledger). Once this data is authenticated and available to all network entities, the care coordinator has on-demand access to complete patient data and, at any given time, can use the aggregate data to monitor and improve the patient's health. The patient's contributions to the wellness goal can also be incentivized based on smart-contract clauses describing the beneficial behaviors and activities specified by the care coordinator.

Patient data collected from sources such as wearable devices, the IoT and clinical information from healthcare appointments should be parameterized at a patient level and attributed to the member. This data will be added as a new record in the patient's electronic health records (EHR) database. With blockchain technology, this data can be decentralized and distributed to other entities in the healthcare ecosystem. The EHR now becomes interoperable; it is no longer confined to either the payer's or provider's information system.

Who pays for the development, deployment and maintenance of this blockchain application system? The answer is outside the scope of this paper, but—regardless of who "owns" the blockchain system—the data must be owned by the members/patient



## 4.2 Blockchain for case management

In the case-management scenario, Block 1 in Exhibit 5 below describes a patient's initial encounter with the care provider and the treatment-plan design. This treatment plan becomes a medical record for the patient, it is added to the blockchain ledger and provides the basis of patient attribution in case management.

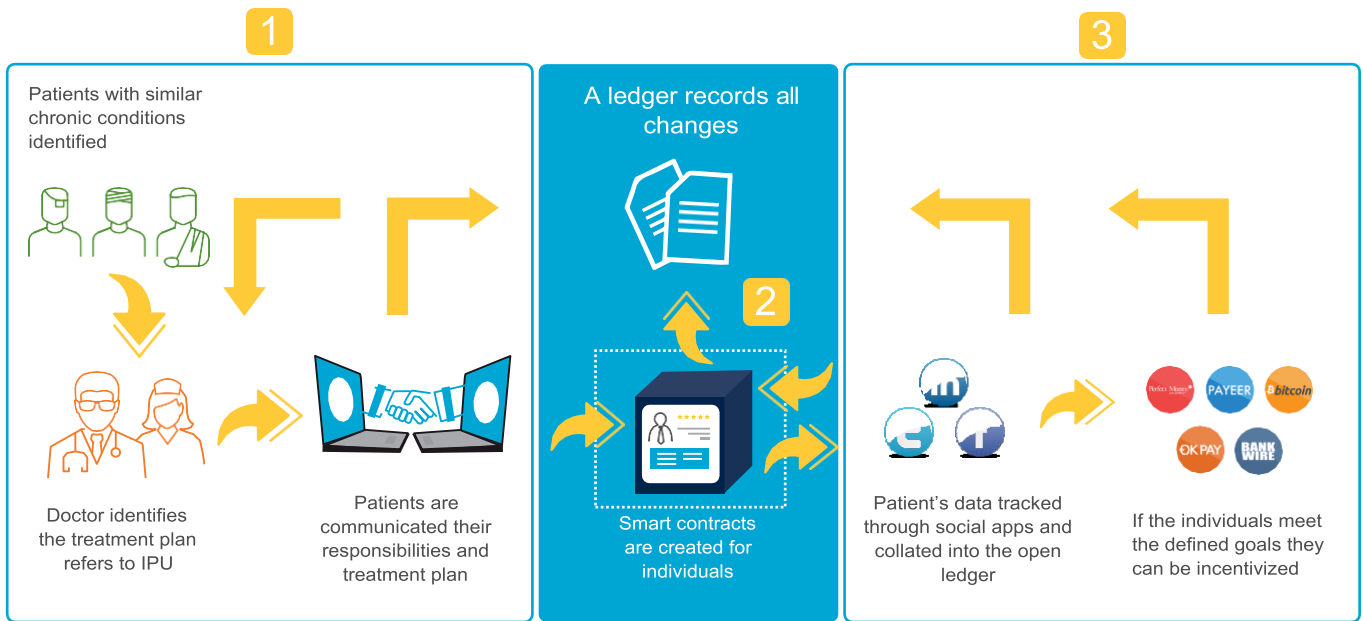
Next, a smart contract is created containing all the attributes for the patient's case management (see Exhibit 5, Block 2). The contact defines the key parameters and wellness goals, and it also incorporates the business rules that are defined to evaluate the patient's progress. This file, once added to the blockchain ledger (EHR), provides chronological care-delivery and patient-response information.



Block 3 in Exhibit 5 describes the process wherein patient's health and wellness data is collected from wearable monitoring devices and social media apps. This data is added to the open ledger as the next block of the patient's record. The rules defined in the smart contract are run on this data, and the patient's overall performance towards the health-management and wellness goals is measured. The patient's contributions can be incentivized as per the terms and conditions of the smart contract.

The main advantage of the above process is that each entity in the network has access to the open ledger, but the patient data can only be viewed once it has been authorized by the patient. This hereby removes the need to have a centralized system and build in access controls to it. It also allows the patient to control the access to his data and hence reduces the chances of data theft. The security aspect of the PHI regulations also taken care by Blockchain technology. This medical data can also be referenced to create a personalized care for the patients without the fear of PHI being compromised.

**Exhibit 5: Blockchain Application for Case Management**





### 4.3. Blockchain for health payers

In today's healthcare-industry environment, payer organizations must stay abreast of market disruptions as they work to become more consumer-centric and cost-effective. With respect to customer centricity, payers are becoming more receptive to the global medical tourism trend. More than 500,000 Americans travel overseas to receive medical care each year.

The global medical tourism market is expected to continue growing, as the demand for affordable, quality healthcare increases. Many of the larger health-payer organizations are exploring opportunities to contain their costs by encouraging members to evaluate the care available from accredited, regional providers open to serving "medical tourists."

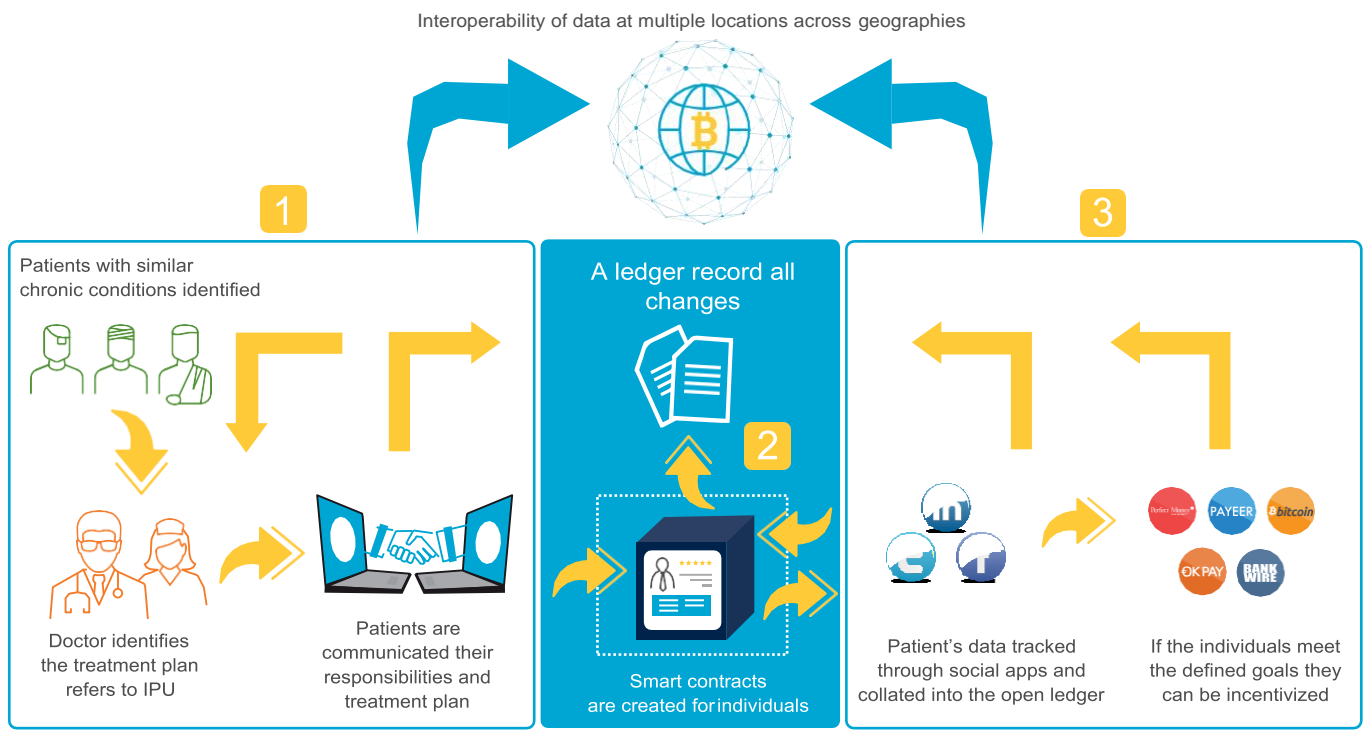
Blockchain technology can enhance interoperability across a global, medical-tourism market, eliminating both system boundaries and geographic limitations. However, a major challenge is access to patients' cumulative clinical data—their medical history—to support better care delivery "in country."

A decentralized, standardized global EHR system can be built using Blockchain technology. Blockchain can support the global mobility of members/patients, providing assurance that their medical-history data can be accessed securely by any provider, anywhere in the world, via the Internet.

Exhibit 6 illustrates how a chronic-care patient's data can be enhanced to make medical-history records available on a global network. This would enable any hospital, regardless of the country in which it is located, to access this data (once authorized by the patient). Subsequently, the patient no longer needs to carry medical records when traveling internationally to receive treatment defined in the medical-tourism policy.



**Exhibit 6: Enhancing Patient Data for Global Interoperability**





## 5 Conclusion

### Blockchain GDP Growth

Only .025% (\$20 billion) of global GDP is currently held in blockchain, but this will increase significantly in the next decade, as banks, insurers and tech firms see the technology as a way to speed up settlements and cut costs. (Hutt 2016)

The healthcare industry, especially in the United States, is a complex system of interconnected entities. Each of these entities has separate, siloed information systems that (1) contain plan-member/patient data and records, and (2) support the (regulated) processes specific to the entity's contribution to the healthcare-delivery value chain. The cost of healthcare delivery continues to increase rapidly, and administrative costs are a major contributor.

Taking into consideration all the capabilities of blockchain technology and our experience in the healthcare industry, we believe blockchain has a huge potential to become the next big technology-innovation engine. Blockchain applications for patient-data portability, interoperability, care-delivery management and administration can provide the answers to many challenges facing this industry.



# Appendix: Blockchain Technology

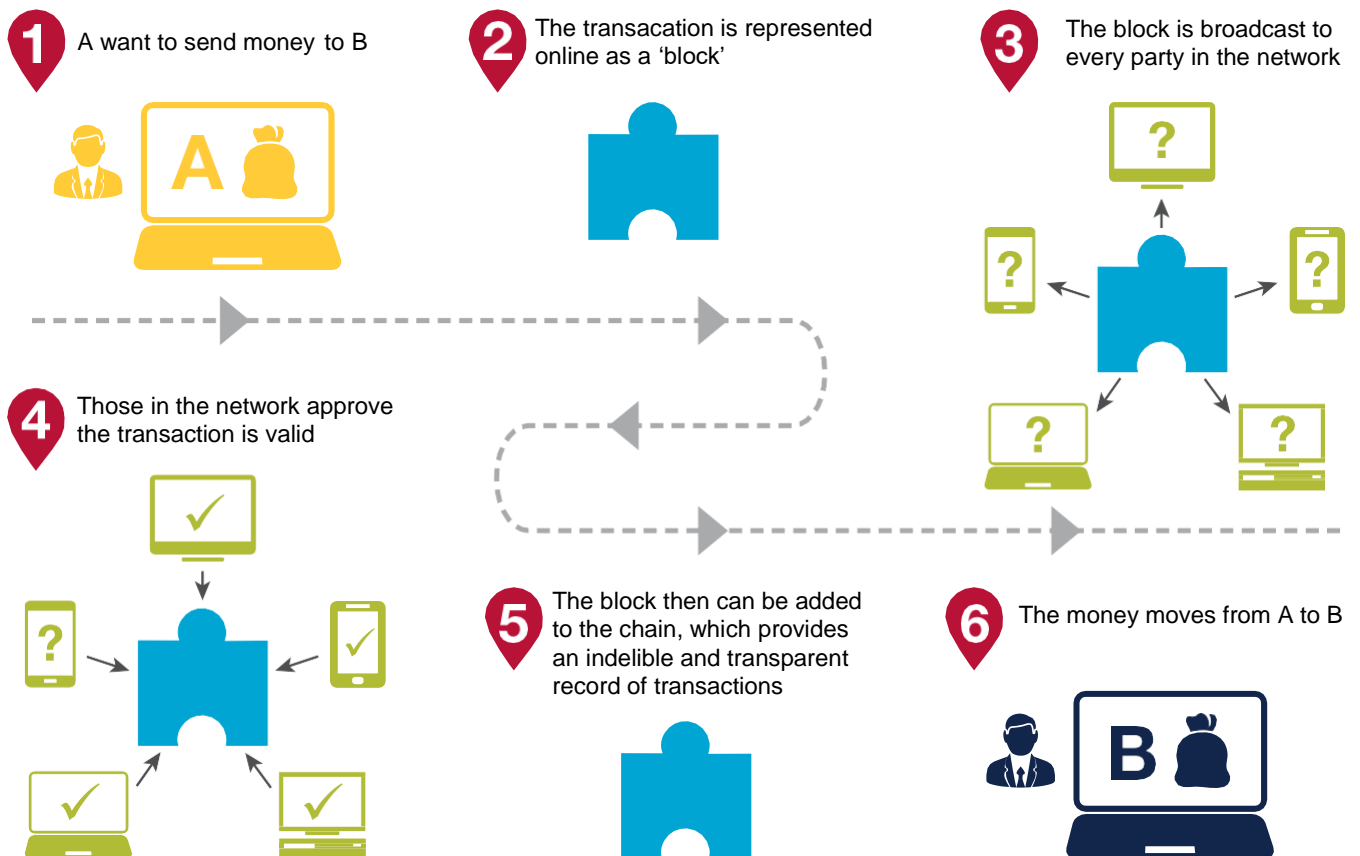
Blockchain consists of blocks that hold batches of valid transactions. Each block includes the timestamp and the link of previous block, with all these linked blocks forming a chain. Everyone on a blockchain-application network can view all the transactions on the chain and also decide if the transactions are valid or not.



How a blockchain works is illustrated in Exhibit A-1.

Blockchain has the potential to be a go-to technology in the financial services industry, but it can be extended across industries to be leveraged to its maximum potential. Anyone with Internet access would be able to use it to make transactions. Currently only .025% of global GDP (around \$20 billion) is held in the Blockchain, according to a survey by the World Economic Forum's Global Agenda Council. But the Forum's research suggests this will increase significantly in the next decade, as banks, insurers and tech firms see the technology as a way to speed up settlements and cut costs.

Exhibit A-1: How a blockchain works





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