BLOCKCHAIN

OPPORTUNITIES AND CHALLENGES IN HEALTHCARE

CHILMARK RESEARCH

MARKET SCAN REPORT

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Executive Summary

Part database, part development platform, part network enabler, blockchain has been touted as the next big thing in some quarters and dismissed in others. The technology that helped make bitcoin a reality could pave the way to a new way of doing business, but how? More importantly, what are the implications for healthcare and how seriously should healthcare leaders be thinking about blockchain?

In this report we provide an analysis of the current state of play of blockchain in healthcare. The report focuses on the nexus of payers-providers and the implications and activities for these two primary stakeholders. Blockchain is currently in the immature technology stage, and surrounded by all the hype and exaggerated promises typical of this stage. Most technologists view blockchain as the next layer in the continually evolving world wide web, one that will offer improved security, distributed storage and services, while creating opportunities for new platform business models. Much of the current interest in blockchain has also been driven by the Initial Coin Offering (ICO) market, which despite a great deal of speculative attention, is unlikely to drive sustainable innovation in the healthcare ecosystem in its current guise.

We begin the report with a discussion of blockchain, what distributed ledgers can actually accomplish, and how they can become a tool for decentralizing services and business models. We argue that blockchain is less of a "disruptive technology" than a harbinger of a gradual transformation of entire industries. By enabling new forms of cooperation, it can be used to address important challenges in healthcare such as data silos and data sharing. The first section of this report also includes an overview of the most important blockchain-supported capabilities, including the ability to create trustless networks, new identity management schemes, and disintermediation of clearinghouses in payment systems. We also look at tokenization, a poorly understood dimension of blockchain, and why it is a source of weakness for many ICOs.

This report also explores a number of use cases, including health information exchanges (HIEs), master patient indices (MPI), provider networks, revenue cycle management (RCM), and claims adjudication. In most of these cases, blockchain is used in conjunction with AI and the cloud as part of an assemblage of technologies intended to address pain points. The success of such projects varies widely. The Vendor Profiles section of this report covers several vendors working in this space, as well as a number of alternative types of distributed ledger technologies.

We conclude our analysis with an overview of challenges around scalability, transaction speeds, and interoperability. We offer a number of suggestions for how the healthcare industry can move the overall ecosystem forward through the development of stronger tools for cooperation that will be essential to unleash the theoretical potential of blockchain to transform the healthcare industry.

Blockchain: What It Is and Is Not

In late 2015, The Economist ran a cover story on The Trust Machine, otherwise known as blockchain, that helped spur interest in this emerging technology. By then, Wall Street had invested billions in developing "private blockchains" through consortia of banks that do business with one another, believing that blockchain could finally disrupt financial services transactions that had been been static for decades.

Meanwhile, barely a day goes by without a naysayer breaking through the hype of blockchain. They point to the history of bitcoin and the illicit use of cryptocurrencies for drug markets, and the notorious hacks of these currencies. Yet, a lot of smart technologists are digging deep into the technology and beginning to innovate around new services that can be enabled by distributed ledger technologies (DLT), which is the basic definition of what blockchain really is.

Almost all of the top IT consulting firms are experimenting with the technology and many are bringing Blockchain-as-a-Service (BaaS) offerings to market. Even the slow-moving, risk-averse world of healthcare has begun to get serious about how blockchain might address very concrete pain points in health systems. While we at Chilmark Research view the notion that blockchain will disrupt healthcare as hubris, we do expect to see a gradual transformation of health IT over the next decade, driven by the convergence of AI, blockchain and cloud computing. We expect this transformation will dramatically alter the health IT ecosystem. But to re-iterate, this will be a decade-long transformation at least, one that will involve many technologies, not just blockchain.

WHAT IS BLOCKCHAIN?

By its most basic definition, blockchain is a distributed, trustless, cryptographic ledger technology. Blockchain is most famously the platform that the bitcoin currency was built upon. The architecture, as well as consensus mechanism for operating the blockchain, was first conceptualize in the original white paper by Satoshi Nakomoto in 2008 entitled "Bitcoin: A Peer-to-Peer Electronic Cash System".[i]

Blockchain is the underlying operating system that makes the digital currency, bitcoin, possible. Thanks in part to blockchain, bitcoin does not require a fiat currency or need to be supported by a nation-state's treasury. It utilizes cryptography, digital signatures, and hashing to record transactions and exchange assets.

Blockchain is immutable [ii] and enables permanent records of transactions that cannot be changed. For transactions where fraud prevention, authenticity, or provenance of data are critical, blockchain can support transaction verification, and reduce fraud or data tampering. Each block (a record of a transaction similar to a page on a ledger that includes a record of the previous transaction) on the blockchain is recorded in historical order so we have a sequential history or audit trail of all transactions.

Satoshi Nakomoto laid out the framework for a system that could:

- Enable direct money transfers between two parties without an intermediary such as a bank
- An immutable ledger that could address the double-spending challenge by utilizing peer-to-peer networks
- Time-stamping of transactions on the blockchain by utilizing proof-of-work methods
- Efficient use of nodes in a network to both protect the network as well as provide a structure that enhances security. The network performs the trust-making duty as William Mougayar (2016) states it.[iii]

Nakomoto's paper is noteworthy for its prediction of a technology that, ten years later, has quickly introduced new ways of doing business across disparate industries.

POINTS OF CONFUSION

One of the points of confusion over blockchain stems from conflicting descriptions: the technology is most commonly described as a decentralized database, yet some refer to it as a data structure. Perhaps the best description comes from William Mougayar who describes blockchain as "part database, part development platform, part network enabler." However apt, such multifaceted descriptions send many heads spinning.

To further complicate matters, the functions of blockchain will undoubtedly change in the coming years as use cases evolve and the shortcomings of blockchain 1.0 are addressed. Blockchain 2.0 will incorporate smart contracts and entail creation of entire organizations run on smart contracts known as Distributed Autonomous Organizations (DAOs).

Similar to the internet, there are also public and private versions of blockchain as well as hybrid versions. Even the cryptographic dimensions of blockchain have a public and private dimension where the hashing of data on a blockchain creates a public record verifying that a data construct is authentic.

TEN BASIC PROPERTIES OF BLOCKCHAIN

Mougayar[iv] outlined ten basic properties of blockchain. The resulting list of functions is important for healthcare and business leaders to grasp in order to see the possibilities that blockchain will enable for decentralized business models and services in the coming years.

1. **Cryptocurrency:** Used as fees in generating smart contracts and act as incentives and/or payments.
2. **Decentralized Computing Infrastructure:** Networked computers power blockchain's networks to make requests to the blockchain.
3. **Transaction Platform:** Once verified, all transactions are recorded on the ledger as a block.
4. **Decentralized Database:** Data is stored on a block (public) linked to a container with a locked signature that can only be opened by those with a private key.
5. **Distributed Accounting Ledger:** The distributed, public, time-stamped asset ledger can be shared in public, private, or semi-private.
6. **Development Platform:** A platform to create decentralized services and business models.
7. **Open Source Software:** Most blockchain platforms, including bitcoin, Ethereum, and Hyperledger, depend on open communities cooperating around different consensus mechanisms to build the code and a network that operate on the system of trust that underpins blockchain.
8. **Financial Services Marketplace:** The cryptocurrency aspects enable new types of financial services or mechanisms for operating these services built upon trustless networks that disintermediate third parties or automate functions requiring intermediaries.
9. **Peer-to-Peer Network:** Architecturally, blockchain is a peer-to-peer network and processing occurs at nodes in the network. Any user can interact with any other user. In this way, it can also enable marketplaces based on distributed economies
10. **Trust Services Layer:** Blockchain eliminates the need for any type of trust broker between parties engaging in a transaction. Anything that can be digitized (assets, services, identities, business logic, terms of agreement) with a value attached to it can be rendered in the form of a smart contract on blockchain.

What It Means to Be Trustless

Blockchains are considered **"trustless,"** which means that a central authority or third party is not needed to validate transactions. Trust is delocalized into a peer-to-peer relationship unmediated by traditional third parties or clearinghouses. This is supported through the use of cryptographic methods requiring data miners who solve mathematical problems that verify the involved parties' identities and record the transaction.

Blockchain uses consensus and cryptography to govern the network and distributes trust across this network rather than through a centralized body. This mechanism for decentralization and disintermediation of third parties and trust taxes is one of the most valuable blockchain features in finance, insurance, and the internet of things where clearinghouse middlemen have a history of slowing transactions and adding transaction costs. This does not, however, necessarily mean the end of clearinghouses completely, but rather disintermediation in some contexts. While many blockchain enthusiasts espouse a completely decentralized libertarian utopia notion of the economy, there will certainly continue to be transactions that require some type of third party or government arbitration.

Smart contracts can be programmed into the blockchain to automate transactions utilizing these tools. (Figure 1) The implications of this may be profound, as trust has become a central obstacle or problem that the past 30 years of technology development have failed to resolve. The healthcare sector is full of challenges linking to lack of trust and centralized business models that stand as roadblocks to data sharing and interoperability.

Small computer programs can execute complex contracts. Specific actions can be verified by third parties, and then triger other events. All this gets recorded on the secured blockchain, and can never be altered after the fact.

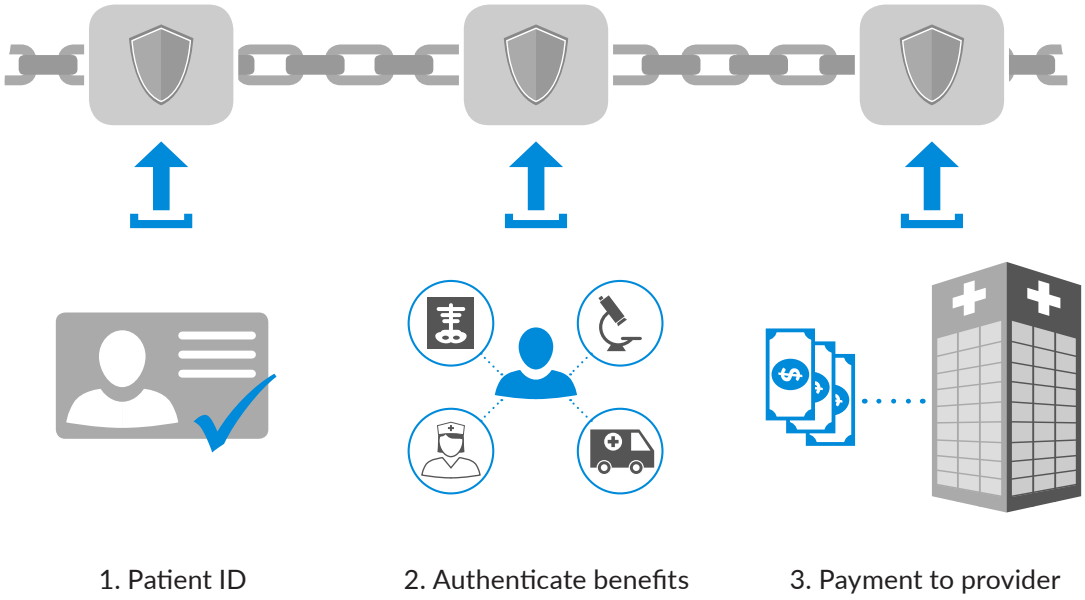

Figure 1: Example of a Smart Contract for Patient Benefits

Sources

[i]

[ii] Immutability is considered one of the primary features of blockchain yet we are now seeing some debate over this and some private blockchains are allowingtransactions to be changed depending on certain conditions.

[iii] Mougayar, William (2016). The Business Blockchain. John Wiley & Sons

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[vii] This section is abstracted from our Gigaom report on Blockchain and Supply Chains. For more in-depth coverage see this report (2017).

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About the Author

Dr. Jody Ranck, author of "Connected Health: How Mobiles, Cloud Computing and Big Data Will Reinvent Healthcare" and the forthcoming "Disruptive Cooperation in Digital Health" is the CEO of Krysalis Labs and Executive Vice President of Strategy at Ram Group, a biosensing company that just released the world's first "Tricorder" technology capable of monitoring vital signs and air quality. He has worked with Chilmark Research as an adjunct analyst on a few reports, generally looking at costs of care and applications of analytics to reduce administrative burdens in the evolving healthcare economy.

With over 25 years of experience in global health, he helped lead some early initiatives in mobile health for the developing world. In the past he has held executive positions with the mHealth Alliance, Institute for the Future, health bank (Switzerland) and has written widely on digital health, wearables and analytics. His educational background includes a Doctorate in Public Health (UC Berkeley), MA in International Relations and Economics (Johns Hopkins University, SAIS), and a BA in Biology (Ithaca College). He has also worked with the Grameen Bank in Bangladesh (1991-92, Fulbright Scholar).

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