



# Blockchain: How it Works and Why it Will Disrupt Health Care

*By Jennifer Boese, MS*



*Create Opportunities*

Blockchain. We have all likely heard of it, read about it, or been told it could revolutionize health care. But what does it really mean for the industry, and when will we start seeing this technology?



The [IBM Institute for Business Value surveyed](#) hundreds of health care payers and providers globally about blockchain. Sixteen percent of those surveyed were what IBM termed trailblazers, of which only eight percent were located in North America.

“Why are so few in the U.S. aggressively moving towards blockchain? There are a variety of reasons, including health care’s capacity to assimilate yet another large-scale disruption in an already rapidly changing environment. However, the potential for blockchain cannot be ignored.”

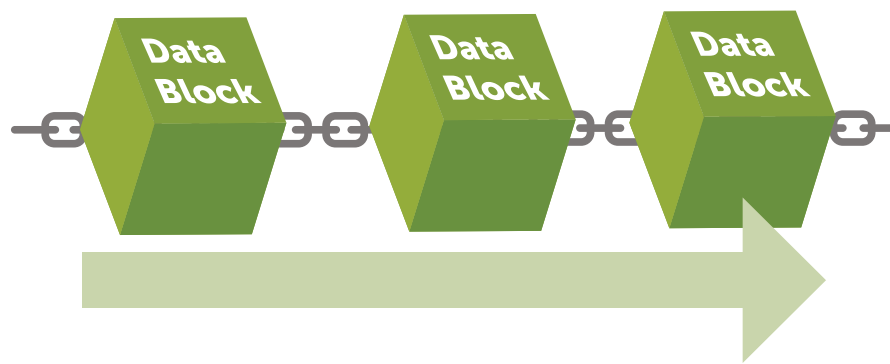
— James Watson, principal and member of CLA’s Future Innovation Team

Health care continues to move quickly into a future where entire reimbursement mechanisms are being altered, technological advancements are exploding, care is being delivered and received in new ways, innovations across the entire system are occurring, and demographics are placing increasing pressures. From robotic process automation to artificial intelligence and the [Internet of Things](#) (IoT), the capacity for health care to assimilate all of these ongoing shifts, let alone a new technology like blockchain, may be too much for all but the largest of entities right now.

Even so, while barriers exist, the long-term potential for blockchain technology is significant. As with any similar advancement, the path forward will be led by trailblazers who help create an easier road for second and third movers to travel.

## How does blockchain work?

In order to understand how blockchain could disrupt health care, we have to understand the fundamentals of blockchain itself. Blockchain is a simple concept based on incredibly complex calculations. As its name suggests, blockchain consists of “blocks” of data that are chronologically stored together along a secure chain of data. Many people have referred to it as a secure “ledger” of transactions, but its potential goes far beyond financial data.



Key elements to look at include how data is *positioned* on the chain, how data is *authenticated* for addition to the chain, and how data is *encrypted*.

There are multiple types of blockchain (e.g., private or federated blockchain) which, as their names suggest, would limit access to the blockchain to certain parties. Public blockchain is the most commonly known since it is used in cryptocurrencies like Bitcoin. Regardless, all blockchains are based on similar principles and are the foundation upon which many applications and solutions are built.

Blockchain is based on cryptography, or the study of how to encrypt or secure information. It has been used for thousands of years, particularly in the military when highly sensitive information must be communicated. Historically, encryption was done using ciphers, such as rearranging words or letters. In order for the end user to read the message, one needed to have the cipher (or the key). Modern day cryptography is based more on complicated mathematical and computational algorithms for encrypting and decrypting information.

“The concept of blockchain has been difficult for many to grasp because of both its technological and mathematical underpinnings, but if we break it down piece by piece, it opens up our ability to grasp just how broad of an impact this technology can have on health care.”

— James Watson

One of the essential algorithms in blockchain is the “cryptographic hash function.” This function is used in several ways (e.g., ensuring that data is placed securely in the correct location on the blockchain). The hash function essentially takes a current transaction and connects it back to prior data on the chain, positioning the newest data at the end and creating a type of date and time stamp. Each block of information is distinct and has its own uniquely calculated signature (its hash). This works to ensure the chronological and secure nature of the chain.

While the hash function makes certain the data is mapped back to the appropriate location on the data chain, in order for the transaction to actually be *added* to the chain, another complex mathematical calculation must occur and be verified by others (computers called nodes) based on a cryptographic puzzle (through a consensus algorithm or mechanism). This authentication function is called mining. Miners are what keep the blockchain “honest” because they verify that transactions should be added to the chain via the cryptographic puzzle. Under public blockchain approaches, individual miners are anyone with the computational power to solve complex calculations. In addition, since other nodes all have copies of the blockchain, proving one copy of the blockchain has been tampered with would be easy.

[Explore how CLA can help you navigate blockchain.](#)



## First Use Case: Blockchain and Bitcoin

In its most recognizable use to date, blockchain was the foundation for a distributive, decentralized system of cryptocurrency called Bitcoin. This was developed and launched in 2008 by an individual(s) known by the pseudonym Satoshi Nakamoto. In the world of cryptocurrencies, like Bitcoin, there is no need for a third, trusted, centralized party (i.e., a bank) to hold onto currency. Bitcoin allowed two-party transactions to take place securely even when the parties did not know or trust each other. Each block of data is mapped to the appropriate place on the chain and then authenticated by miners, thus allowing the two parties, who each have their own private keys, to securely and confidently send and receive Bitcoin and complete transactions.

It is important to remember that Bitcoin is not blockchain. Rather, blockchain technology facilitates applications like Bitcoin and other cryptocurrencies.

Another key element of blockchain uses public-private key cryptography. While the public key is a known algorithm and the data is public, certain user information is made private using a separate, private key algorithm. Private keys are needed for any transaction on the blockchain.

Simply, when we combine the hash function (which securely links and positions data on the chain) with mining (which authenticates legitimate transactions to be placed on the chain) and with public-private keys (which serve as an encryption function), blockchain is the foundation for a linear, chronological, one-way, immutable chain of data.

### Use cases for blockchain in health care

The underpinnings of blockchain are security, transparency, integrity of data, and its distributive nature (which makes it difficult to tamper with or manipulate).

“If we then think through blockchain’s characteristics, it could be useful in any number of health care processes or transactions where secure data, transactions or information transfer is needed. The options seem limitless.”


— James Watson

A few examples of how blockchain could work in the health care industry include:

- Financial transactions or processes (e.g., revenue cycle functions, contracts, or supply chain)
- Sharing of medical records (e.g., health information exchanges or sharing of clinical data for research)
- Consumer-focused uses (e.g., telehealth or purchasing health care services)

The following use cases show how blockchain could provide opportunities and solutions to problems that exist in the industry today.

**Revenue cycle** — Since there are ongoing, repeatable transactions within health care’s revenue cycle, there are many potential opportunities to use blockchain. Consider the current back and forth between providers and insurance companies for claim submissions. Blockchain could be employed to facilitate these transactions, automate various functions, facilitate the entire process, and create a secure audit trail. This is probably one of the most advanced health care use cases for blockchain. As organizations look into the future, it will be important to consider the implications of Medicare or other large health care programs running on blockchain.



Providence St. Joseph, a 51-hospital integrated health care system, [purchased Lumedic](#), a revenue cycle management company built on blockchain that also uses smart contracts and machine learning to improve the revenue cycle process.

**Smart contracts** — Whether undergoing a construction project, ensuring property rights, purchasing supplies or devices, or facilitating financial functions, organizations can use blockchain combined with other functionalities like smart contracts, also known as self-executing contracts. In a smart contracts, actual contract provisions are written into computer code and self-execute when certain conditions of the contract are met.

For example, think about a construction project between a senior living community, a contractor, and subcontractors. Terms are agreed to, code is written to reflect the terms, and a smart contract is created using technology like Ethereum. When each stage of work is completed, contract terms (like sending a payment) are executed. Or if work is not completed by a certain date, then payment could be withheld or reduced. Whatever is decided upon, a smart contract executes based on those terms.



[Ethereum](#), a public blockchain smart contract technology, is open source and allows developers to create their own applications on top of the Ethereum blockchain. This removes the requirement for an entity to have to create its own blockchain.

Let's push even further into a future use case for blockchain and smart contracts: consider valued-based insurance contracts or payment models. Think about the potential for blockchain and smart contracts for managing a payment model like an Accountable Care Organization (ACO). All entities and providers involved in an ACO could come together under agreed-upon terms. They create their own Decentralized Autonomous Organization, which is run using blockchain technology. The governing requirements for quality metrics, shared savings payments, and other terms are written into a smart contract. Other applications, like patient medical records, could be added on top of the blockchain, thus removing interoperability concerns and allowing all providers (and patients) in the ACO to access the data they need in order to manage care delivery better. A distant future? Yes, but one with loads of potential.

**Supply chain** — Smart contracts allow organizations like pharmaceutical companies, medical devices companies, and providers to make transactions easily and securely, and have a chain of records that removes any product integrity questions. There are any number of opportunities to employ blockchain and smart contracts within the supply chain. For example, a pharmaceutical company could use blockchain and smart contracts to ensure its product is safe and

secure throughout the supply chain process — from raw materials, production, packaging, shipping, and ultimately the product's arrival at locations across the globe. The Federal Drug Administration, which oversees pharmaceuticals, has also recently [partnered with blockchain company TraceLink](#) on a blockchain project for the drug supply chain.

The [Center for Supply Chain Studies](#) has been working on a proof of concept (phase two) of a study related to the pharmaceutical supply chain. The study is called DSCSA & Blockchain (related to the 2013 law, Drug Supply Chain Security Act). [Phase one of the study involved research with simulated models and included](#) stakeholders across the pharmaceutical supply chain.

**Medical records or clinical information sharing** — There is an ongoing problem with interoperability of medical records between multiple stakeholders. One opportunity to solve this issue involves using blockchain to manage medical records securely while also determining who can access them. Health care providers are already contemplating and testing blockchain in these capacities. For example, Medrec is the outgrowth of testing being done by MIT and Beth Israel Deaconess Medical Center with support from others, including the Robert Wood Johnson Foundation. Mayo Clinic has also recently signed an agreement with European blockchain company [Medicalchain](#) to focus on medical records.

[EHRchain](#), [Medrec](#), and other systems are all current examples of patient medical records being managed by blockchain. EHRchain uses a private blockchain and places the patient in control of their own medical record. Because those patients are able to give access to any provider, the medical record is virtually with them wherever they go. EHRchain claims over 90,000 total records are already on their blockchain.

Along the same lines of how to provide access to medical information while also protecting it, blockchain could be used by researchers and patients who need or want to share medical information for research or clinical trials.

**Consumer applications (telehealth, virtual health, and purchasing health services)** — There is immense potential for how care is accessed and paid for by employing blockchain with related applications. For example, [Change Healthcare](#) began using blockchain with telehealth and has implemented a claims management solution in this space. They also recently acquired [PokitDok](#), a platform-as-a-service (PaaS) health care company, which allows them to expand these and others types of applications. Blockchain is also well-positioned for the connected IoT, including consumer wearables and [remote patient monitoring data](#).

**HealthCoin+** is a currency an individual can use to set up their own health “wallet.” These virtual wallet health coins can be used to pay deductibles to providers who are also on the platform.



If we return to our Bitcoin example, and replace Bitcoin with health coins, we now have an entirely new model for accessing and paying for health care services based on cryptocurrency. In the near term, health coins could be ideally suited for providers and patients who operate outside of the traditional

insurance model, like those using direct primary care or concierge care. They would also easily allow for co-pays or deductibles (or more) to be paid at point-of-service. Virtual care like telehealth or e-visits could be used and paid for virtually with blockchain as its foundation. In the long-term, the potential for innovation in accessing care by using cryptocurrency, combined with virtual delivery of care, could upend elements of the current insurance and health system market.

## Notable blockchain concerns

We have focused heavily on the potential for blockchain in the future, but there are real obstacles that still need to be worked out as this technology moves forward, including:



**Privacy concerns** — The first use case of blockchain was Bitcoin, a public application which everyone has access to, can initiate transactions, and can be involved with the verification process (assuming they have the computational bandwidth necessary). The main principle underlying Bitcoin was that open access and transparency create the most security. However, people who know where to look can exploit this open access and use metadata to determine patterns of behavior. How does this paradigm fit with health care when privacy is essential?



**Security** — Even though blockchain proponents say it is immutable and secure, there are still security risks. Bitcoin has been hacked already. There is also the problem of the “51 percent attack” in which a majority of computers that have copies of the blockchain come under one entity’s control. While this control would be difficult to obtain, it is possible. Blockchain would only be as secure as its underlying architecture.



**Regulations, laws, and compliance** — Health care is a highly regulated industry and governed by a complex set of laws and regulations. Take the Health Insurance Portability and Accountability Act (HIPAA), which protects patient medical information and creates additional requirements for certain aspects of this information, such as mental or behavioral health records. How can blockchain ensure compliance with the patchwork of laws and regulations in health care, or will these requirements need to be updated?



**Electricity and power** — The computational processes used for mining the blockchain take up immense resources. This means it takes a lot of electricity and power, which is less environmentally sustainable, places strain on the grid, and could disadvantage (or advantage) certain locations based solely on electrical capacity.



**Reliance on a technically sophisticated workforce** — Blockchain and its applications are likely best understood by those with the technological aptitude for it. Right now, health care already has a capacity shortage for tech workers, so more reliance on these individuals places additional strain on the system. There are many corollary issues with this as well, including how blockchain impacts the overall health care workforce itself. For example, will employers need to offer higher salaries in order to secure scarce tech workers and reduce salaries for others in the system? How will dollars within the system be redistributed? Will this exacerbate the ongoing issue of the lack of diversity (e.g., gender and minorities) within tech and in health care?



**Disruption in health care** — A large barrier to blockchain adoption is that it is novel, complex, and difficult to digest. In a world where health care is undergoing its own restructuring, it will be difficult to adapt yet another disruption as large and complicated as blockchain. It will be important to consider that health care leaders and patients may not *want* to adopt yet another disruption. This is likely the reason that IBM Institute for Business Value found so few blockchain trailblazers in the industry in North America — there may simply not be enough bandwidth to incorporate blockchain while handling the other disruptions facing health care today.

## How we can help

Blockchain is in its nascent stages of exploration and experimentation in health care, but there is tremendous long-term potential that comes with the real-world barriers hindering its quick adoption. Regardless of where you are on the path to blockchain, CLA can help you [understand, plan for, and implement this technology](#).

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## About the author

Jenny Boese has 20 years of public policy and government relations experience, and has spent more than half of her career dedicated to health care policy and the health care industry. Her role at CLA is to provide thought leadership, policy analysis, and strategic insights to health care providers across the continuum related to the industry's ongoing transformation towards value. A key focus of that work is on market innovations and emerging payment models. Her goal is to help CLA clients navigate and thrive in an increasingly dynamic health care environment.



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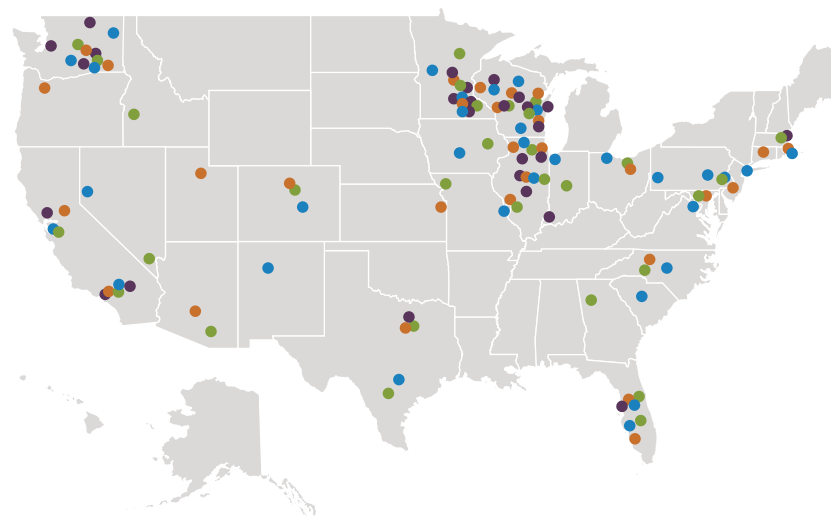
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