

WHITE PAPER

Curbing Fraud and Improving Health Data Privacy Using Blockchain

Submission for the Office of the National Coordinator for Health Information Technology Ideation Challenge

News headlines are filled with stories of the latest breaches of patient information. Exposing sensitive medical information is damaging enough, but stolen identities ripple through the health system in the form of fraudulent medical billings and fake prescriptions. While post-payment audits and claim reviews recover some monies, the ultimate goal is to prevent fraud and instill trust within the healthcare ecosystem. Blockchain technology has the potential to positively impact our health industry in many ways. One way is to help prevent fraud and improve data privacy across the healthcare spectrum. In this white paper, we focus on its potential benefits in the area of prescription fraud.

A Driving Need

PATIENT IDENTITIES COMPROMISED

In 2015, more than 113 million medical records were compromised in the United States, according to the U.S. Department of Health & Human Services (HHS) Office for Civil Rights.¹ According to NorseCorp, a California-based cybersecurity research firm, “a medical record including name, date of birth, Social Security Number and clinical data

can sell for \$60 a piece on the black market whereas credit cards information can sell for about \$20.”² Health information is a lucrative black market.

Stolen records are used for fraudulent billings, opening credit lines and blackmail, and can lead to erroneous entries that put the real patient’s life in danger (think deleting allergies or adding new health conditions into the fraudulent transactions to secure specific medications).

A FOCUS ON FRAUD REDUCTION

Fraudulent billing is an ongoing issue facing healthcare today. The Government Accountability Office (GAO) reported that 10% of the Medicare budget (nearly \$60 billion) is lost to improper payments, affecting every facet of healthcare—such as phantom office visits, inappropriate hospital charges and false pharmacy payments.³ In addition, according to a May 2015 annual report on healthcare fraud from HHS and the Department of Justice, a national long-term care pharmacy provider entered into two settlements “for a total of \$31.5 million to resolve claims that it violated the FCA (False Claims Act) and the Controlled Substances Act.”⁴

The government alleged that the organization dispensed and billed Medicare for Schedule II controlled substances without valid prescriptions.

Drug diversion, the illegal use of legal drugs, costs healthcare payers in excess of \$72 billion annually in direct drug related costs and larger hidden costs of treating the addictions it supports.⁵ The Department of Justice works collaboratively with the health industry to curb fraudulent transactions, and specifically related to pharmacy, the Drug Enforcement Agency offers proactive guidance to pharmacists through its “Pharmacist’s Guide to Prescription Fraud.”⁶

Types of drug diversion include:

- “Legitimate prescription pads are stolen from physicians’ offices and prescriptions are written for fictitious patients.
- Some patients, in an effort to obtain additional amounts of legitimately prescribed drugs alter the physician’s prescription.
- Some drug abusers will have prescription pads from a legitimate doctor printed with a different call back number that is answered by an accomplice to verify the prescription.
- Some drug abusers will call in their own prescriptions and give their own telephone number as a call back confirmation.
- Computers are often used to create prescriptions for nonexistent doctors or to copy legitimate doctors’ prescriptions.”

But more is needed.

Understanding Blockchain and the potential in healthcare

WHAT IS BLOCKCHAIN?

During the development of Bitcoin (a new type of digital currency), a method was needed to record and validate transactions in a decentralized and secure manner. This need was met by the development of Blockchain. To simplify, a Blockchain is a collection of validated pieces of information—blocks—linked to the others by adding the newest blocks to the existing chain. With Blockchain, users could validate and track their Bitcoin transactions, because it maintains a permanent and secure record of these transactions.⁷

Information that was written within the block consisted of items such as the amount of the transaction, the organization to which it was paid and by whom. This information was added to prior information about past transactions. The protocol surrounding the Blockchain and the stored information within the block was able to serve as the “trust element.” This trust element meant that the parties involved were able to make the transaction with confidence that it would be validated.⁸

Because the “trust element” is normally provided by financial institutions, Blockchain does not need a centralized agent. The trust element inherent in Blockchain is an important reason for Bitcoin’s success and it is one of the major reasons for the heightened attention and substantial recent investment into this emerging industry.

WHAT IS THE POTENTIAL OF BLOCKCHAIN?

Blockchain is a transformative technology. It will change, at the minimum, the way healthcare, financial firms and governments perform many of their activities. Also, it will impact other industries such as law, accounting and product validation. It is believed by various thought leaders in the industry that several long-standing business functions and professional services may no longer exist. These losses will be a result of structural changes caused by firms using Blockchain technologies or a similar system.⁹

Advancing healthcare by learning from the financial industry

Over the past year, implementation of Blockchain technologies has been making significant progress in the financial industry. In this paper, we have considered how security, accuracy and timeliness challenges affect the financial industry, and how their application of Blockchain’s transformational technologies may serve as a model for the healthcare industry. Financial services companies must live up to the standards of trust, reliability, precision and accuracy without fail. Every day, companies are upholding the standard and innovating to stay competitive and meet rising customer expectations.

Achieving efficient, effective communications between software applications and external payment networks is difficult. The current process provides limited transparency, long settlement windows and high processing and operational costs. Introducing new technology into robust legacy systems, meeting constantly evolving message standards and abiding by increased regulations compound this challenge. CGI recently implemented our Blockchain-enabled Intelligent Gateway as one of the first integrated financial messaging solutions in the industry to provide instant settlement of domestic and international financial transactions. We see this model as directly applicable to healthcare.

Use Case: Applying Blockchain to healthcare for securing patient identity and reducing fraud

Blockchain technologies will require healthcare participants to be identified, and for transactions to take place via the “trust element.” What this means is that the patient, provider, pharmacist and payer will engage in a secure and fully recorded (aka “ledgered”) transaction. Each transaction is encrypted to help assure that unauthorized access cannot compromise patient privacy. Theoretically, the result will be eliminating fraudulent (or preventing the tampering of) transactions in a secured environment. If Blockchain gains mainstream adoption, patient health, privacy and safety will be safeguarded, and healthcare costs will be lowered due to increased efficiency across the board.

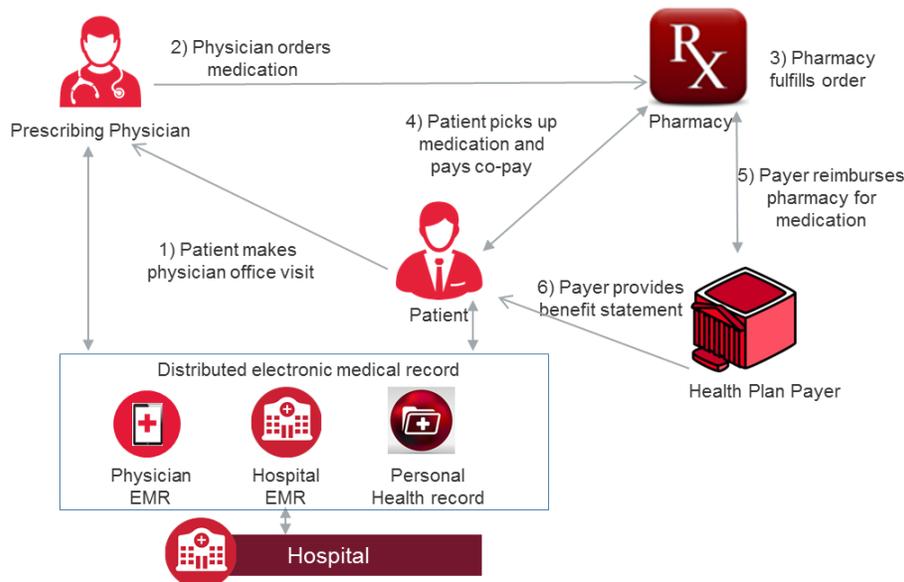
IMPACT ON DOCTORS AND PATIENTS

Patient records managed by Blockchain have significant security needs and by themselves represent a compelling idea. Blockchain technology creates an honest, unchangeable, globally accessible record that remains secure. However, adaptation to such a radical approach requires the de-centralization of the data which, understandably, makes many people nervous, no matter how encrypted and well managed. Such a change in thinking and approach would likely meet with opposition from privacy and patient groups, and would certainly be subject to the court of public opinion, which ultimately would have the final say.

Yet, some organizations are moving the concept ahead. There is a notable case study of Blockchain used to facilitate the management of medical records in Estonia.¹⁰ While we will not go into details here for this initiative, Guardtime is employing a Keyless Signature Infrastructure (KSI), a Blockchain technology solution integrated into an Oracle database engine that delivers mass scale data authentication without dependency on a centralized trust authority. Citizens of Estonia have in their possession

a unique identifier which links them to their personal medical record. We see this, and lessons learned from the financial industry, as a key to other innovations in healthcare. As described earlier, the U.S. health industry still faces many challenges related to accurate and timely access to patient health information. We also know that the confirmation, execution and payment of legitimate pharmacy transactions remain a significant challenge in healthcare delivery. Therefore, in order to showcase a real-world example of the promise and potential of Blockchain, the remainder of this white paper focuses on a single use case of a patient requiring an expensive prescription drug. The below diagram, *Blockchain-Enabled Processes in the Prescription Drug Process*, provides a glimpse into the complexity of just a small facet of the healthcare ecosystem—from accessing accurate and complete medical records, to an accurate, secure and legitimate ordering process, to the filling and billing of prescription drugs. Blockchain solutions hold the potential to greatly improve these processes, enable cost-reductions and dramatically increase accuracy—thus providing a tremendous value to all participants, but especially to the patient and to society at large.

Blockchain-enabled Processes in the Prescription Drug Process



HOW BLOCKCHAIN CAN BE APPLIED TO THE USE CASE

- A healthcare transaction (whether an entry to the electronic health record or ordering a medication) is generated as a set of actions that can be grouped in the form of tokens for a secured Blockchain network
- The last block confirmed is used to create the new block with an identifier or a pointer

- The next step is to validate the token with the following information (but not limited to):
 - Healthcare actions
 - Enrollment information
 - Proof of insurance
 - Diagnosis and procedure codes for treatment
 - Recognized peers for review
- Digital signatures of the validators are added to the block (using hash) and the initial set of actions is extended to include the validity token from the confirm health actions.
- Block creation and information distribution: After validation, block identifier, digital signatures, peer reviews and the set of healthcare token miners calculate and generate the new block.

In each of the next sections, we will describe a functional view leveraging Blockchain technologies, and describe the “trust element” for each participant as well as the benefits.

1 – The patient is scheduled for a physician office visit.

“Peter Patient” has had multiple health issues and has seen his primary care physician as well as various specialists. Last year, he had a hospital stay where he had a pacemaker implanted. Peter keeps track of his health using a personal health record where he logs activity and over-the-counter (OTC) medications. The distributed electronic medical record becomes a key component of Peter’s overall health as clinicians in various settings have access to a trusted source of data. Peter’s identity as well as medical history must be protected.

In advance of the office appointment, “Dr. Physician” has been able to review the distributed medical record to see what has occurred during the hospital visit, acknowledge what has transpired with other doctor visits, and review Peter’s activity log and OTC medicines. This gives the doctor a complete and accurate picture of everything that has happened to Peter, better preparing him for Peter’s visit and next steps.

Patient trust element: The patient is provided with a code (private key/PK or hash) and an address that provides the codes to unlock his or her patient data. While the patient data is not stored in the Blockchain, it provides the authentication or required hashes (multi-signatures or multi-sigs) to be used to enable access to the data (identification and authentication). The patient defines in their profile the access rules required to

unlock their medical record. If the patient defines 2-out-of-2 codes, then two separate computers (the hashes) would have to be compromised to gain unauthorized access to the data. In this case, establishing unauthorized privileged access becomes very difficult when the machines types differ, operating systems differ and they are hosted with different providers. Blockchain's potential benefit to the medical information space is largely tied to its multi-sig features. Here, data is hashed onto the Blockchain, and then, through the use of multi-sigs, access can be gained only by those who have been granted access.

Benefits: Patient identity, access and transactions are a more secure, scalable, tamper-proof alternative to current legacy models. Additionally, the highly decentralized nature of Blockchain mitigates central points of failure.

2 – The physician orders medication.

During the office visit, Dr. Physician is able to talk with Peter about his recent history and can update his electronic medical record through Blockchain.

Dr. Physician has been tracking Peter's blood flow volume and is recommending a medication called Entresto. Because Dr. Physician has a trusted and complete medical record for Peter, he can see other medications that Peter is using (including OTC) and has access to a genetic profile for Peter indicating that the prognosis for using Entresto should be positive. Entresto is expensive (approximately \$400 per month).

Dr. Physician uses his e-prescribing system to select the pharmacy convenient to Peter and orders the medication.

Provider trust element: Contributors to a patient's medical record (e.g., physician or hospital providers), or a physician ordering a medication, are given a separate universal signature (codes, hashes or multi-sigs). These hashes, when combined with the patient's hash, establish the required authentication to unlock the patient's data or, as part of this use case, combined as part of the prescription medication order with the pharmacy to confirm the authenticity of the transaction.

Benefits: Authenticated transactions confirm the legitimacy of the prescription order and medical record updates.

3 – Pharmacy fills prescription order

The "Finest Pharmacy," near Peter's home, receives the Entresto order from Dr. Physician.

Pharmacist trust element: The pharmacist, like the provider, is given a separate universal signature (codes, hashes or multi-sigs). These hashes, when combined with

the ordering physician's hash, establish the required authentication to proceed. As well, secure transactions with the health plan confirm coverage, eligibility, cost and co-pay. At medication pick-up, this transaction is then combined with the patient's hash required to authorize and release the medication.

Because the Blockchain is in place, the pharmacy knows that this is an authorized and legitimate order. The pharmacy verifies Peter's active coverage under "The Perfect Health Plan" and is able to confirm Peter's eligibility for 80% of the drug cost with the remaining 20% as the co-pay owed by Peter.

With Blockchain, a patient could provide access to their own file by directly granting access to a provider such as a pharmacy. Because the identity of the participant is verified every time a transaction is added to the Blockchain—whether by the doctor, pharmacy or health plan (for supporting payment and co-payments)—it can also be verified by any other of the transaction's participants.

Note that the rules of co-pay and insurance would have to be factored into the patient information. The patient is always in control as to what data is being sent and to which party.

Benefits: This use case reduces the lack of information, the uncertainty and some of the hassles that chronic health consumers have to deal with to obtain their repeat medication, thereby reducing the "burden of disease." But it does not only benefit the patient. Because all of the exchanges are registered on the Blockchain, everyone can check to see if the data is accurate and still valid. The benefits to suppliers of medication will be tremendous. They will be able to instantly verify if, and when, the prescription is "signed" by a certified doctor and know whether it is a new order or a repeat order for medication.

4 –The patient picks up medication and pays the co-pay.

Peter Patient is notified electronically that his prescription is ready for pick-up at The Finest Pharmacy. Peter goes to the pharmacy and confirms via electronic signature that he has picked up his prescription. He pays the 20% co-pay using his digital wallet that securely and within seconds moves the funds from his Health Savings Account (HSA), or other source, to the pharmacy.

Activities described in Step 3 demonstrate how all authorized participants have access to the same information. This entitlement will be granted to the patient by the providers, who will build their own applications using reference rules to allow for secure communications with other registered and relevant participants on the network.

Benefits: Patients have a more seamless transaction and the pharmacy has a real-time payment against a validated and trusted transactions.

5 – The payer reimburses the pharmacy for the medication.

At the same time Peter pays his co-pay at The Finest Pharmacy, the health plan receives an alert that the transaction is complete and then reimburses the pharmacy for their 80% cost of the drug—within seconds of the patient’s payment. In this example, it will be safe, secure and highly efficient because the data exchanges do not require added steps or questions about the order from the physician, the patient, the pharmacy or the payer.

Health plan trust element: Information related to the patient’s coverage and eligibility for prescription drugs is part of the transaction. The transaction cycle between the pharmacist (on behalf of the patient) and the health plan, each using their own unique hash, confirms the legitimacy of request.

Benefits: During the payment process, there is no question about the validity of the transaction. With the validated circle of truth between patient, provider, pharmacy and payer, the health plan can pay the prescription benefit with certainty that it is legitimate and not subject to payment review or audit.

6 – The payer provides the benefit statement.

With a Blockchain-enabled process, Peter Patient has consistent access to his transaction history which is reassuring to him. For recordkeeping, The Perfect Health Plan issues a monthly electronic statement to Peter showing a full history of his doctor visits as well as the prescription drug transactions. It is not necessary for Peter to submit further claims for reimbursement or to receive multiple bills or explanations of benefit or to file a claim against his HSA, because all of the transactions are secure, accurate, timely and complete.

There are also options for Peter to use Bitcoin payments to pay his premiums. Overall, auditing of transactions and the transparency with the identified users and timestamps validation is fair, efficient and in a trusted environment.

Benefits: The patient has complete transparency into the process enabling them to see information regarding the transaction from start to finish.

Summary

Secure. Trusted. Accurate. Timely. While Blockchain is still in its infancy, the pioneers who are considering its application to healthcare believe in its promise. As the future unfolds, there is no doubt that the collective thinking will evolve and countless other ideas will emerge. For now, we see just the start of Blockchain-enabled processes in healthcare, and as we continue, we see an industry transformed. For the use case

discussed in this paper, we see Blockchain securing patient identity and curbing healthcare fraud in the following ways:

- A patient-centric distributed medical record that is protected from identity theft and contains a protected and complete view of medical record information, allowing physicians and other clinicians to make better diagnosis and treatment decisions
- A significant decrease in the number of fraudulent prescriptions as compared to today, enabled through Blockchain's unique ability to create the bond between the patient, the provider, the pharmacy and the payer who are all validated and aligned during the prescription ordering, filling and payment process. Preventing fraudulent prescriptions would save billions of dollars in improper payments and recovery operations annually for Medicare alone.
- An industry-leading authentication and encryption response to the changing data privacy requirements that is now expected by the public and demanded by healthcare regulations

About CGI

Founded in 1976, CGI is one of the largest IT and business process services providers in the world, delivering high-quality business consulting, systems integration and managed services.

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