CHAPTER 15

Rise of Blockchain Consortia

This chapter is transcribed from a conversation between Vikram Dhillon (VD) and Katherine Kuzmeskas (KK) from Tamarin Health on her journey of creating a blockchain company, the challenges faced on the way, the evolving nature of consortia, and the future of her company.

VD: What were the main customer pain points that you were trying to solve with the company? How did this evolve with time? What roles did the blockchain play in all of this? Can you give us some kind of a timeline?

KK: When we first started, we were focusing on value-based care. This is an area of healthcare where physicians are being reimbursed for the outcomes they provide as opposed to the volume of services they provide. This has been around since 2008, originally started by Medicare (through Centers for Medicare & Medicaid Services [CMS]), then private payers followed the lead. I learned about value-based care by being a hospital administrator at Yale New Haven Health, and while I was there I needed better tools to manage patients once they physically left the hospital (or, put differently, post-discharge management). This is very challenging because once a patient leaves the hospital, their data is largely inaccessible, and new health data generated from follow-ups sits in silos created by a myriad of clinical applications that are not interoperable. We wanted to be the longitudinal connector of the patient, their care, and their data. As a connector, we have access to data on patient care, regardless of clinical location, that provides information for our provider customers and us to act on, and provides real-time estimates of savings or penalties based on the target price that CMS sets. The target price is basically the total cost of allowable reimbursement by Medicare; as a result, this is the total cost of care [that] providers should stay below.
We came out of the gate with this idea when we were incorporated in early 2017. The blockchain connection initially began as a way to create an audit trail of all the longitudinal data in our platform. Ever since we defined how we were going to leverage blockchain in 2016, our focus was to intentionally start with a simple and basic implementation of blockchain: an audit trial for transition-of-care information and insurance reimbursement for value-based care that occurs across different settings. Once this audit trail is created, it cannot be deleted or modified, and this is really important in value-based care because the patient is transitioning between different practices, data sits in different locations, and the only entity up until now that had this complete view was Medicare via its claims data. Looking back to reconcile the care of the patient can be very difficult if you cannot trust or validate the sources of information. We wanted to solve this problem of connecting the patient through[our] their care and providing an immutable audit trail of the data, improving the reliability and trust in the data. Plans were always centered around growing features after proving this core concept. We wanted to test our foundation in the market, and once blockchain technology became more scalable, [and] broadly adopted, and people became more comfortable with it, we could grow, and the opportunities become endless with use in healthcare.

Along with the audit trail, we have always been focused on providing the ability to govern access to data in a meaningful manner through a public–private keypair system. These two concepts, an audit trail and public–private keypair system, have guided our growth through value-based care toward our future, where patients can share their data via simple clicks and benefit from it.

In addition to allowing patients to govern access to their data, another area of interest for us is insurance reimbursement. Many value-based-care programs are presently retroactive, meaning you look back to reimburse, but with blockchain, you can make this system prospective. While there will still be human processes needed, there are exceptional efficiencies we can create for the system, including leveraging smart contracts to distribute funds automatically. With our base foundation Health Nexus (a healthcare safe blockchain protocol), the keypair system that governs access to data, and all the smart contracts that we can build on top of our Health Nexus protocol, more prospective value-based-care programs may be possible in the not-too-distant future.
Editor's Note  Healthcare-specific applications that interface with a blockchain are subject to a rapidly changing regulatory landscape, which makes the discussion very challenging. The authors are sharing their viewpoints here in a purely academic manner.

The evolution in our approach accelerated during the early phase of COVID-19. Once the pandemic started, I became nervous about how value-based patient care would be impacted in regards to hospital admissions due to COVID-related strain on healthcare facilities. Eventually, I made a very difficult decision to withdraw from the Medicare program. My reasoning behind this pivot was rooted in the delay in communication from CMS, and based on how the CMS value-based care systems are set up—specifically bundled payments, which is the main program we support. Presently, a physician provider is responsible for the care of a patient over a ninety-day period after discharge from the hospital regardless of where the patient goes, and largely regardless of what happens to the patient. There are very few exceptions to this ninety-day patient care cost bucket. For example, any readmission during the ninety-day period can result in a penalty if the cost of the readmission pushes the total cost of care over the target price. Meaning, if a patient came to the hospital for a hip replacement, and then had a fall leading to a fracture in the arm within the ninety-day period, the cost of the arm fracture falls into the total cost of care for the hip fracture—even though they are unrelated. This is not an ideal situation, and certainly not ideal in a pandemic situation where patients developed severe complications such as pneumonia, cardiac issues, or were put on ventilators.

To give a timeline: The first public health emergency was January 31; by March 13 the White House declared a federal emergency; on March 18, Medicare declared that all elective cases should be postponed so that physicians [could] remain focused on COVID-19 cases and emergency care. In a non-pandemic setting, value-based care roughly operates similar to an insurance program, where the elective cases done by a hospital system can provide reimbursement to balance out high-cost emergent cases. This pandemic shifted the dynamics of reimbursement because of the near sole focus on high-cost critical care, extended hospital stays, and strained healthcare resources. Despite the timeline above and the struggle that all physicians were going through, Medicare provided no guidance until June 28. Earlier guidance was limited to Medicare saying they [were] working on something and would release it “soon.”
When I made the decision to pause our Medicare value-based-care focus, I looked at our technology stack more critically. We had an existing platform where we could follow individuals as they transitioned through different modalities of care and tracked their records. So, we began to focus on how we [could] help employers across any industry gather safely during the reopening phases of [the] COVID-19 pandemic. Our platform is able to consolidate external sources of information such as those through health surveys, testing coordination, and general public health awareness/knowledge. Blockchain continues to play a key role with the very simple, intentional audit trail that can be a necessary resource for liability protection and reimbursement. The information we gather on our platform, from symptom surveys to test results, is hashed and becomes a part of the audit trail. In the same way that our platform tracked patients through different modalities of value-based care, an employer can use our new service for data collection to verify that an employee completed a survey and attested to what they put in the survey; as a result, the employees can safely gather in accordance with public health guidelines. Additionally, business owners can document the safety of their workplace from a liability standpoint. Having an audit trail that verifies data reduces the burden of regulatory compliance. That’s where we are now.

This shift accelerated our evolution to another significant component of our company vision: user-owned health profiles. Since 2017, we have created a platform where healthcare data flows seamlessly between parties, a network of high-performing, value-based-care-focused physicians, and now a network of user-owned health profiles. Every user owns their healthcare information and carries it, from basic health information to more complex data such as procedures and medications. Over time, the value of the data grows and the user is able to contribute it to our data marketplace, also a key component of the growing ecosystem. With this infrastructure, you will be able to find healthcare providers and services that are dedicated solely to value-based care, you will derive value from your data, and the opportunities are endless in finding ways to create a self-sustaining, value-based-focused ecosystem.

Up next in our user-owned health profiles is adding gamification. For the COVID-19 focus, gamification rewards what will become mundane but required safety protocols such as daily symptom surveys. We will start first with gift cards, but our long-term goal is to tokenize the system, since the base infrastructure is Health Nexus, which requires node runners and validators. The whole idea with tokenization is to incentivize group behavior for providers and patients in this new ecosystem. Because tokens can only be used within the system, this is how the ecosystem will be self-sustaining over time.
However, this gets very tricky due to the current regulatory environment; any discussion of tokenization becomes an expensive and lengthy process with the SEC. Pocketful of Quarters, an organization attempting blockchain gaming with tokens, already experienced this in their more-than-a-year-long discussion with the SEC to obtain a No Action Letter, which allowed them to launch their network. Healthcare is already laden with regulations; introducing blockchain and tokens only adds another layer of complexity, and, while doable, will take time and significant expense.

**Note** The tokenization concept is near impossible in the current legal environment. Pocketful of Quarters has demonstrated that launching a network is possible. But not without significant cost and time. Tokenization as globally understood in concept is very different from what is currently possible in the United States.

**VD:** The core of this chapter is about your consortium model. Tell us more about the proposal for the consortium. Why was it optimal to choose the consortium route? What benefits would members receive in a consortium model?

**KK:** As you know, we created Health Nexus, which is a public–private healthcare-safe blockchain protocol. *Public* meaning you don’t have to be part of the consortium to access the blockchain network. The private side is more involved. There are two requirements in order to run a node on the network: you have to be an approved and authenticated consortium member, and additionally, you have to run a HIPAA-compliant server.

There are very practical reasons that we took this route. Blockchain is a new technology, and you have to educate IT-security teams along with C-suite executives that even though you are offering a blockchain-based tool, your technology is safe. Ultimately, you will have to explain what decentralization means, and your customers must be comfortable with your system. If your customers are not able to understand the benefit of a decentralized protocol or the safety and security of how health data interacts with the infrastructure, there is no way to secure customers. The learning curve to understanding blockchain at a fundamental level is so steep that lack of trust in [the] network becomes a non-starter in many industries, but particularly in healthcare. Teaching the basics of a blockchain leads to questions about the servers. If you mention that a server can be anywhere in the world, you have to be able to explain—in a way that is comprehensible by your customer—why that is not a security risk.
As such, current perceptions of existing decentralized blockchain protocols drove our decision to create Health Nexus. Bitcoin has always had legislative and perception challenges, particularly with a history of Bitcoin exchanges linked to Silk Road activities. Trying to build healthcare applications on a platform linked to historic illegal activity is already a non-starter—it makes conversations with the customer’s decision makers impossible. Ethereum is a public model in the truest sense: any user, anywhere in the world, from any country can run a node. We expected that any company that builds on top of our protocol will have to answer questions from healthcare ITS departments about who runs the network. An answer of “I am not sure” or “It looks like folks in other countries”—including those on the Federal Sanctions List—creates a non-starter, which would be the case with Ethereum. In addition, the need to explain this in depth to the ITS department will extend the already long sales cycle for healthcare applications. Again, both of these issues are perception based, but that alone is the issue affecting adoption. Having to explain away Silk Road or servers in countries that are on our OFAC Sanction list adds unnecessary complexity.

Being able to describe a network of known-node runners who are required to maintain a HIPAA-compliant server to run a governance-based blockchain speaks more of the healthcare language than Bitcoin or Ethereum can; thus, the core infrastructure and design of Health Nexus. There are two aspects to the private interface on our network: no one can access your healthcare data without your private key, and secondly, we know who runs the nodes in our network. The servers are all HIPAA-compliant, and your PHI-protected data is not hosted on the blockchain itself. We only use the ledger for propagating metadata links in blocks and [for] transactions that can only be decrypted with a private key. You come to a level ground on this protocol. That’s why we call it “healthcare safe.”

The reason we took a consortium route is to create this public–private interface. We wanted to create a public network, but it could not be completely permissionless. So, we designed a validation process where anyone who runs the network can validate and verify that potential consortium members are indeed running a HIPAA-compliant server. You can charge a fee for this service, the same way any HIPAA-compliant company pays someone quarterly to test their systems and maintain their HIPAA compliance.

There are technical requirements for becoming a consortium member, and the validation process is two-dimensional: you have to be validated at first by a current consortium member (validator), and then you have to be voted in. New members go through a formal voting process involving the entire consortium and must keep their
node available at all times. For the voting process, new members have to describe why they want to join the consortium, their past experiences in blockchain and healthcare, and their interests and commitment to maintaining their role as a consortium member. Then, the consortium votes whether or not to bring new members on board. All members have equal voting privileges, including our company, and the vote is stored on-chain for all member-related actions. To that end, any members can be kicked out for being malicious, and there is a low threshold for tolerating risky actions or inactivity. In the past, through vote, we removed a consortium member due to inactivity. This process ingrains governance into consortia blockchain, and also helps to maintain the protective nature of healthcare entities. This governance process is shown below in Figure 15-1.

**VD:** Overall, building a blockchain company is difficult, but you managed to overcome several hurdles. What were the major challenges? How was the fundraising process? Tell us about the NSF grant that you received. Any new features or ideas that you’re very excited about?

**KK:** It was surprisingly easy to find our early consortium members, as we already had a large network to reach out to. The hardest part has been keeping members engaged (i.e., mining) without a monetary benefit that exists in other, grandfathered blockchain networks such as Ethereum. Even though our technology has been ready since fall 2017, we have only been able to launch our test net due to the expensive and lengthy SEC process that will be necessary for [the] main net launch. We are grateful that, up to now, some members have been running our network out of the goodness of their heart and because of their dedication to blockchain’s long-term impact in healthcare. Unfortunately, at this time true blockchain applications in healthcare are very difficult in the US, particularly due to the legislative climate. The necessary shifting in policy will create a more open environment for digital assets across all industries.

Interestingly, in 2020, everyone is excited about DeFi, so it feels like blockchain is “popular” again and we can actually talk about blockchain. From 2018 to 2019, nearly everyone denounced blockchain tech. Innovating in healthcare is very challenging, but innovating with a new technology such as blockchain in healthcare is even harder. We have found success precisely in our strategic focus on keeping the technology as simple as possible (a basic audit trail to start) and building in a way to create a safe adoption for healthcare (focus on a public–private protocol and emphasis on governance).
With regard to fundraising, of course it has been challenging, but particularly due to systemic biases that drive decision making. Right now, women receive only 3 percent of all fundraising dollars. In comparison, WeWork received more investment funds than all the female founders combined in 2019, and we all saw how that turned out. Fundraising can be an uphill battle, and is increasingly more challenging depending on your gender, race, and ethnicity. While we did manage to get the investment we needed in 2017, it was an arduous journey.

However, through grants and loans, the federal government has been much more supportive in funding our company than investors. Specifically, we received a highly competitive Phase I Small Business Technology Transfer (STTR) grant from the National Science Foundation for our research implementation of Graphene on our Health Nexus protocol. Our university partners were Dr. Brian Levine and his postdoc student Dr. George Bissias of the University of Massachusetts–Amherst. Dr. Levine is the director of the Cybersecurity Institute in the College of Information & Computer Sciences, where he focuses on security in the context of the internet and mobile systems, including child rescue, privacy, blockchains, cellular networks, and peer-to-peer networking. Drs. Levine and Bissias had successfully implemented Graphene on the Bitcoin blockchain. Our goal, which we achieved, was to similarly leverage this block propagation technology on Health Nexus to compress block size, improving blockchain performance. As the industry continues to wrestle with the complexities of decentralized systems such as speed, energy consumption, and efficiency (including cost), we are proud to have proven that Graphene is an effective tool in making a blockchain more efficient. Using the least amount of bandwidth and latency as possible has numerous advantages for a decentralized blockchain, and we are confident [it] will contribute to necessary innovation and efficiency in healthcare.
Figure 15-1. Governance cycle in Health Nexus