



How Blockchain Will Change the Way You Develop Medical Devices

Presented on April 5 2018, by Jad Mubaslat, Founder of BitQuick

Jad Mubaslat: Let's forget about how many of you have invested in Bitcoin. How many have just heard of Bitcoin or blockchain?

Now, how many of you feel like you understand it? Okay, perfect. Then this presentation is made for you.

So, "how blockchain will change the way you develop medical devices." It's a little bit of a clickbaity title. It's not going to completely revolutionize how you build medical devices, but it is going to revolutionize how that data flows in the background, and how effective your medical devices can be, and how they can take advantage of the data going around.

So I'd like to give a thank you to 10XTS, they helped me get out here. They are a blockchain venture lab building enterprise blockchain products and solutions. So if you're interested in learning more about blockchain or you want to try and implement blockchain into what you're doing, check out "10xts.com"

So, who am I? Like I said, I'm Jad Mubaslat. I have a bit of a unique background. I'd like to think that this is the perfect scenario for me to talk about blockchain and also healthcare. My academic background — I have a biomedical engineering degree from Ohio State University, focused on tissue engineering, and I also just recently got my master's degree in Industrial and Human Factors engineering from Wright State University, where I studied the application of blockchain to the healthcare space, specifically care coordination, but medical devices just as well fit inside of this entire healthcare ecosystem.

I'm also the organizer of the Dayton Bitcoin blockchain and cryptocurrency meetup. And, like Joe mentioned, I founded a Bitcoin exchange back in 2013. We were acquired back in 2016, so I'm just an



advisor for them now. But they're actually still going strong. So, if you do want to dip your toes in the water, buy some Bitcoin, go check out "bitquick.co"

So I mentioned I was working on a master's thesis that focused on blockchain and healthcare. If you want to check out the full paper, 9xc.us/10x — Demonstrating the functionality and efficacy of blockchain based systems in healthcare using simulation tools.

So within that paper, you'll find some more directed readings in the literature review. Some of those actually go in depth of all the different applications that blockchain can have in the biomedical and healthcare space.

And we also have an in-depth review of "how does blockchain Bitcoin work?" and "how can we simulate this in a healthcare system?"

So first, if we want to understand how this technology is going to revolutionize the healthcare industry, finance — even past these two industries. Think about real estate. Multiple industries are going to be affected by this. It's similar to thinking about the internet didn't necessarily change how medical devices were made, but the fact that your medical devices can now be connected to the internet changes the way you think about things.

So now hopefully after this presentation, the fact that blockchain exists and how blockchain functions will hopefully get your mind to think about what additional capabilities your medical devices could have.

Bitcoin

So let's start with Bitcoin, the original blockchain. It was released in 2009 after the financial crisis by a pseudonym, Satoshi Nakamoto. No one really knows who that is. It doesn't really matter. They released some open source code and a white paper that described it. People just ran with it from there.

So what Bitcoin did — it is a digital currency and a software that, for the first time in history, allows anyone anywhere around the globe to send any amount of money virtually instantly with a low fee and, most importantly, without a third-party intermediary like a bank or PayPal or Visa, someone telling you who you can and can't send money to. You're essentially immune to financial censorship in this kind of system.

Bitcoin & blockchain today

And if we look at Bitcoin and blockchain today, Bitcoin has a market cap of about 117 billion dollars. And if we look at the total market cap of all tradable tokens out there, it's somewhere around 260 billion. Now if we look maybe just a month ago, it was about three times this amount. So, this is not financial advice whatsoever. Don't take it as such.

We've also seen \$8.8 billion raised by these initial coin offerings. Companies creating tokens saying that these tokens will one day have value or one day will provide some kind of function in our new product. And we also have major players in finance getting involved. You have futures being traded by the CBOE, CME, so you have even Wall Street involved at this point.

How?

So, how does Bitcoin work at a very high level? Let's say Bob wants to send .1 bitcoin to Allison. This creates a transaction that we see at the bottom. This transaction will go float in an unconfirmed transaction pool.

So everyone who is running the Bitcoin software, they have a copy of these unconfirmed transactions. These transactions aren't final, but we're just trying to broadcast to everyone on a best-effort basis that we're trying to have this transaction settled and put into the blockchain.

You've probably heard about miners. It's like "what the heck are these miners doing? They have shovels? They're digging something in the ground?" A better term for miners is think of them as transaction validators.

We have people running specialized computers that are trying to group together transactions that are not confirmed yet and, every 10 minutes, one of those miners will win a lottery-esque system, put together a block of transactions and append it to the Bitcoin blockchain.

So once your transaction is included inside of one of these blocks inside of the Bitcoin blockchain, it is now permanently stored in an immutable distributed ledger.

And these miners are rewarded with Bitcoin for their services. So they're actually incentivized to validate transactions in a proper way because, otherwise, all that power that they're dedicating towards the system is going to go towards nothing. If they attack the system and they put bad transactions in the blockchain, their investment is going to be worthless.

Key implications

So some key implications — We've created a trustless method to transfer value without a third party. We've created an auditable, provable, immutable log of transactions. Each one of those blocks is cryptographically connected to the previous one.

So if we manipulate any content within one block, let's say a block that was mined in 2013 or something like that, everyone will be able to see through cryptography, basically advanced mathematics, that that modification is invalid.

And third, with these public blockchains like Bitcoin, we have a financial incentive for everyone to behave honestly by rewarding digital tokens to these users and minors. So in the case of Bitcoin, those are Bitcoins. But we also see other cryptocurrencies such as Ethereum that rewards Ether to their users. We'll talk briefly about some of these other technologies.

So, what is a "blockchain"?

So, at its heart, a blockchain is simply an append-only, cryptographic, hash-linked ledger. And we have two types — we have public blockchains and we have permission blockchains. And I imagine that they're going to affect the industry in different ways.

Public blockchains, anyone can participate in them. You guys want to go run your own Bitcoin node, run your own Ethereum node, run your own Monero node, feel free to do it. No one is going to tell you that you can or cannot participate in such a system, but the drawback to these systems is there are some privacy concerns.



Anyone can go on the Bitcoin blockchain and see transactions that are being made. In fact, there's a lot of speculation that the NSA and whatnot has already been able to de-anonymize some significant percentage of users on the Bitcoin network.

We also have scalability issues. Whenever I make a transaction, every single other user on the Bitcoin network is going to have a copy of that transaction in their Bitcoin blockchain. The current Bitcoin blockchain is some 200 gigabytes of data today. So it's quite large and, like I said, it's append-only. It's only going to get bigger.

So then we look at permission blockchains. These are blockchains where the identity of the participants must be known. There is no underlying cryptocurrency incentivizing people to use these.

So there, you have —

- privacy benefits in the sense that only the people that are allowed to use the system can see the transactions happening;
- scalability, we're not putting transactions from everyone on this blockchain; and,
- it's easier to integrate these with legacy systems. You don't have to haggle and discuss with the entire Bitcoin community to get your particular function implemented. You're creating and running your own blockchain.

But the drawback is these private blockchains are not going to grow as quickly as public blockchains. They're censorship-prone. The people that are working together, maybe it's six EMR providers working together, there's a more centralized point of failure. It only takes compromising six entities in that scenario versus with the Bitcoin network, you've got some thousands of users that are running copies of this ledger. So it's much more difficult to attack a public blockchain than a private blockchain.

So in terms of the implications to you guys, my prediction is that these permission blockchains are going to be easier to integrate with the industry incumbents. Good luck trying to convince ePIC to adopt this new public blockchain system. They might be more likely to adopt their own private blockchain.

But on the flip side, if we start seeing these healthcare blockchains that are public, that anyone can participate in, that anyone can buy their tokens, the same way that Bitcoin attempted to disrupt finance from the ground up — it's a product meant for consumers — that's how you might see these public healthcare blockchains disrupting the healthcare space.

So the private blockchains, they will be implemented from the top down, whereas the public blockchains, I think in the end, are going to dominate as they will be disrupting from the bottom up. Maybe there's going to be a lot of consumers using these blockchains, and the data will simply be so valuable that healthcare incumbents will have to integrate that data into their systems.

Do you need a blockchain?

So quick way to think, “Do I even need a blockchain for what I'm doing?” Check out this flowchart —

- So do you need a database? If you don't need a database, you certainly don't need a blockchain.
- Do you need many people to write to it? We need multiple participants. So if you have multiple participants, all right, we're on the right track.

- Do those people trust each other? If they don't, then great. We're still on the way to needing a blockchain. If they all trust each other, it says, "You don't need a blockchain." The fact is, actually, you might be able to use a private blockchain.
- If there's one person in common that they trust, well then, you might as well just use that centralized database. You don't really need a blockchain in that case, either.

But if you answered yes, yes, no, and no, you need a blockchain.

Care coordination and major themes

So my studies at the university, we focused on care coordination. And within care coordination, we have multiple stakeholders. We've got providers. We've got hospitals, and there's interdependence among each other. They need to have access to each other's roles and resources.

And the same thing with medical devices, if we have a consumer that has, let's say, a Fitbit, it might be useful to have that data being fed into this ecosystem, so that information can be actionable immediately.

Blockchain and healthcare

And when we look at blockchain healthcare, it might be bigger than you think. We're looking at various use cases. We even see medical devices and IoT security down there, Spiritus and NeuroMesh. Those are startups working on blockchain with medical devices today.

And actually, if we look at Patientory, Meta Block, Medicalchain and MediShares, these are four blockchain healthcare projects that currently have tradable tokens. And in February, the total value of those four tokens was trading at \$400 million.

Now realistically, it's probably somewhere down in like 250 million as many of you block Bitcoin holders have been feeling the pain recently.

Blockchain features and capabilities

So let's talk about the features and capabilities that a blockchain has.

The technical features —

- we have an **immutable ledger**. All that information when it's put in the blockchain, we can't change it. It's cryptographically secure;
- we have **consensus** among the participants as to the state of that blockchain; what data do we perceive to be valid? We have a set of rules that we use to determine that;
- **smart contracts**. Now, these aren't present in Bitcoin, but when you look at Ethereum, another blockchain platform, smart contracts are basically functions that can automatically execute depending on data that happens on a blockchain. So let's say you want to automatically issue some kind of report, if you receive data from a patient that they've hit some kind of threshold, some kind of goal for their health, you could have a smart contract automatically trigger some kind of reporting or payments could automatically be issued;
- we're looking at **multi-signature**. This is the idea that we can have addresses controlled by multiple parties;
- **cryptography** — that's involved in the underlying infrastructure for all blockchain-based systems;



- we also have **asset digitization**. So, for instance, the ownership of a certain medical device could actually be put on a blockchain and be represented as a token. So if someone holds that particular fraction of a token, fraction of a Bitcoin, that could also mean that they own such a medical device; and,
- these networks are naturally **peer-to-peer**.

And these lead to certain operational capabilities —

- we're now able to **transfer value**. In the case of Bitcoin, it's just money. But if we look at Ethereum or these other blockchain-based systems like hyperledger, we're able to actually transfer data from one party to the other;
- we also have **security**;
- we have **auditability**. Anyone can go look at this blockchain and see the history of the blockchain; and,
- we have **decentralization of trust**, in the sense even if we're looking at a private blockchain as opposed to relying on one person to manage all the records — Just look at Equifax. That might not be the best idea — we're now depending on six. That's better than one. Or in the case of a public blockchain, it could be an infinite number of participants.

And it's important to note that having an immutable ledger and consensus are the key features that lead to these operational capabilities.

Healthcare requirements

And so within my work for my thesis, we also tried to identify the healthcare requirements in general. And we see that we have cost reduction, fraud prevention, identity management, record availability. We want HIPAA compliance; we want universality of records, auditability, reconciliation of records, interoperability, and a way to encourage patient engagement.

So we see these operational capabilities, some of them contribute to enabling different healthcare requirements. We see that auditability enables eight out of the ten healthcare requirements out there.

So just the ability to audit the records of a certain patient or the data that a certain medical device is outputting, that's going to help you achieve many of the requirements that these healthcare systems have and that these medical devices have.

Potential design

To give you a mental model about how could such a system work - are you going to have all this medical data sitting on the blockchain itself? Well, no, that wouldn't be efficient.

So what we're going to do is this — for example, if you see looking at this MDChain blockchain, what it's doing is it's storing pointers to the actual local database records. So you're still using the classical databases that we already have. But now, we're actually able to link them together using the blockchain.

So you think of it as the mortar that's connecting these different bricks, these different databases together. And so hospitals, patients, payers, local provider offices would all be feeding data into their databases, and they would have record locators on the blockchain to those databases.

What can you do?

So what can you all do?

- Stay aware of blockchain developments. Coindesk.com is a great place to check out general blockchain news;
- Consider how blockchain may apply to your use case specifically; and,
- hire developers that are familiar with blockchain.

So in conclusion, we see that blockchains have the potential to disrupt more than just finance alone. Healthcare systems and the medical devices within them can be greatly improved by implementing these blockchain solutions.

If you want to send me an email — jadmubasat@gmail.com — and if you want to check out my LinkedIn — jadmubaslat.com

Feel free to reach out to me. Happy to talk about blockchain, Bitcoin, healthcare, whatever. You name it. Now happy to answer any questions.

Joe Hage: That was fascinating. Would you say that it's almost certain that blockchain, as I've heard, is the new internet — just as pervasive. It was nothing, and now you can't be without it? Is that the future of blockchain?

Jad Mubaslat: I do believe that, yes. It might be five, maybe even up to 10 years before we actually interact with blockchain applications on an everyday basis. In the same way that, back in the 90s, who knew that we were going to be using the internet every single day for every single thing? Who knew that it would lead to this entire phenomena of social networking?

So I think, in the same way, we're going to see similar disruptions from the blockchain industry.

Joe Hage: Do you think the average user or average manufacturer is going to know how to use the blockchain or will it be in the background and we don't even know that it's happening?

Jad Mubaslat: The end goal is for the consumers. You're not going to have any idea that you're using the blockchain.

The same way you don't really care how Facebook's backend works, but at the same time —

Joe Hage: I do now.

Jad Mubaslat: Yes, I guess so **[laughs]**. Right. But in the same sense, we want to abstract blockchain away from the user and just provide them with the benefits.

Joe Hage: From where we are to having something on the market, is there one that's just so intuitive for medical devices that it's almost certainly going to lead the way and others will take that as the permission to believe that, “Yes, we really have to change the way we're doing business?”

Jad Mubaslat: I think it's difficult to predict exactly what's going to be the killer use case. In the same way during the dot-com bubble, we had things like pets.com that were popping up. I think, in the same sense, where we're not so sure what's going to be the killer application here.



But, for instance, maybe just looking at provider data or having your medical device actually have access to information from other medical devices in a live manner. Maybe it's using a public blockchain and these users are now incentivized to actually participate in the system because they're rewarded with tokens. So there's a lot of different ways that could go.

Joe Hage: Thank you very much. Yes, that was great. Are you a consultant? Can they hire you for your time and advice?

Jad Mubaslat: So I'm not officially doing consulting, but I did just graduate. I'm going to start working for a Bitcoin exchange coming here soon. But like I said, happy to answer any questions. And if there are more involved projects, we can talk.

Joe Hage: Any friend of MDTX is a friend of mine. Jad, thank you so much.

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