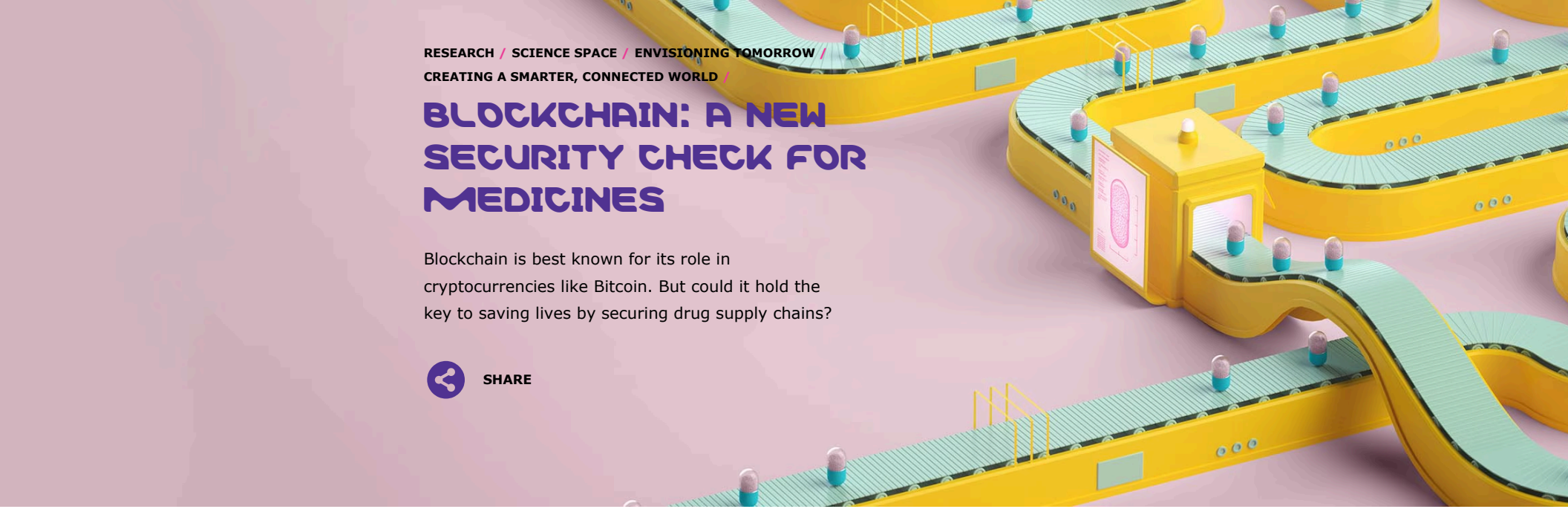
BLOCKCHAIN: A NEW SECURITY CHECK FOR MEDICINES

Blockchain is best known for its role in cryptocurrencies like Bitcoin. But could it hold the key to saving lives by securing drug supply chains?



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FAKE DRUGS - A REAL PROBLEM

When you pick up a prescription from your pharmacy, it's unlikely you'll think to question the pills or medicine you've been given. The drug markets in most developed countries are highly regulated and a huge amount of care is taken to ensure that the treatments that reach our pharmacies are exactly what they say they are on the packet.

However, in less regulated markets – and increasingly even in more highly regulated ones – a dangerous trade in counterfeit drugs is on the rise. In fact, the World Health Organization (WHO) estimates that 1 in 10 medical products in low- and middle-income countries is substandard or falsified.[1]

Pharmaceutical supply chains are increasingly complex. They can often now span across multiple countries. Products manufactured in one country may be packaged in a second country and distributed across borders to be marketed or sold to consumers in a third.

The growth of e-commerce also contributes to the complexity of the issue by making it easier to purchase medicines online in any country, often from unauthorized sources.

Often counterfeit drugs are disguised as the real deal', using the same branding,

packaging – everything that a patient would expect from the genuine drug. Yet these fakes are often entirely ineffective or contain dangerous contaminants.

The trade in fake drugs is now thought to be killing hundreds of thousands of people globally every year. Falsified antimalarial drugs alone are responsible for up to 155,000 children dying annually.[2]

Tests on drugs in circulation have identified fake and ineffective copies of a vast range of medicines including antimalarials, antibiotics, cardiovascular and cancer treatments. Many fakes originate in China and India and have been found to contain unhygienic or dangerous materials like brick dust, sheetrock, and printer ink for fake coloring.[3]

The pharmaceutical industry has invested billions into defensive measures, but so far, their efforts have only slowed rather than stopped the counterfeiters. According to PwC, the most common anti-counterfeiting tactics block about half of the fake drugs, at most. [4]

Such problems seem worlds away from Bitcoin – a 'cryptocurrency' invented in 2008. But the cryptographic technology that underlies Bitcoin – the blockchain – has applications well beyond cash and currency, offering a new way to create digital trust in the supply chain and potentially prevent fake drugs from reaching patients.

DID YOU KNOW?

10%

of medical products in low- & middle-income countries are substandard or falsified.[1]

155K

children die every year due to fake antimalarial drugs. [2]

50%

of fake drugs are blocked by current anti-counterfeiting measures. [4]

WHAT IS BLOCKCHAIN?

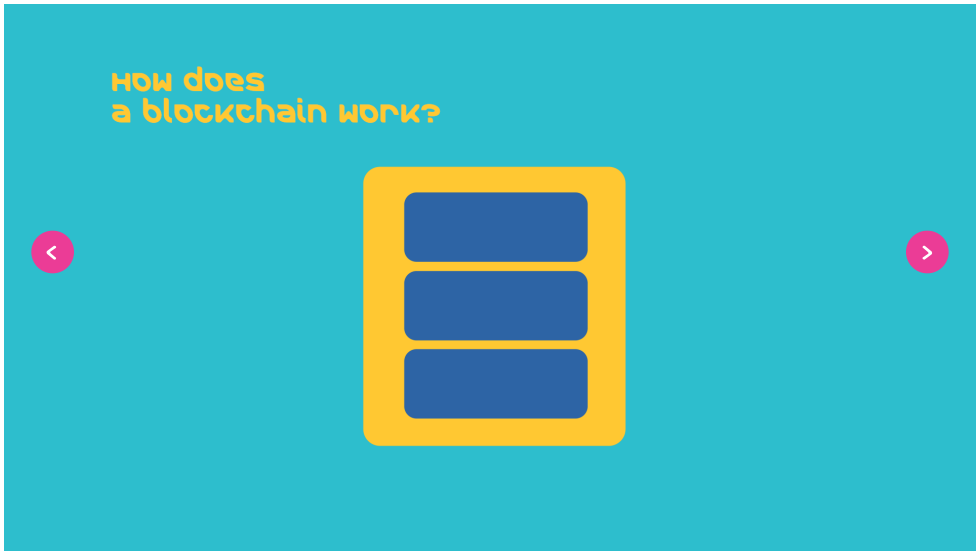
Satoshi Nakamoto, the pseudonymous and so far unidentified creator of Bitcoin, created blockchain technology to realize his idea.

To work as cash, Bitcoin had to be able to [illegible]ge hands without being diverted into the wrong account so it couldn't be spent twice by the same person. Normally, avoiding such abuses is down to trusted third parties, like the banks. But in Bitcoin, the blockchain has replaced this trusted third party.

At its most basic level, a blockchain is literally just a chain of blocks. But the words 'block' and 'chain' in this context, actually mean digital information (the 'block') stored in a public distributed database (the 'chain').

Blocks on the blockchain store information about transactions like the dates, times, or amounts spent. Depending on the size of the transactions, a single block can hold a few thousand transactions.

They also carry information about which accounts are participating in each transaction, so each amount spent can be traced back to its point of origin.



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Transactions

When a block stores new data it's added to a blockchain, which consists of multiple blocks strung together. In order for a block to be added to the blockchain, four things must happen: 1. A transaction must occur. Or in many cases, multiple transactions, as a block will group together potentially thousands of transactions.

A 'DISTRIBUTED LEDGER'

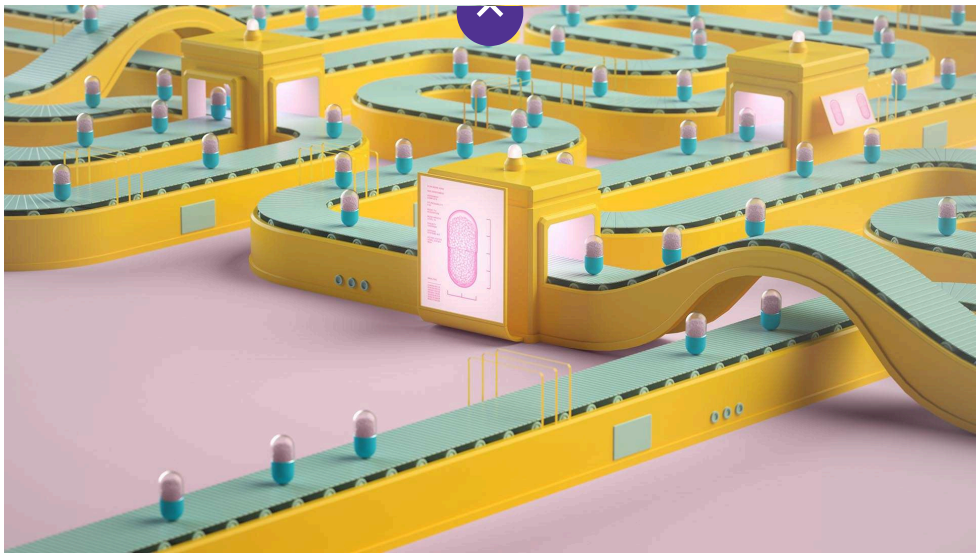
Anyone can view the contents of a blockchain, but users can also opt to connect their computers to a blockchain network as ‘nodes’. This means their computer receives a copy of the blockchain that is updated automatically whenever a new block is added.

Each computer in the blockchain network has its own copy of the blockchain, which means that there are thousands, or in the case of Bitcoin, millions of copies of the same blockchain.

“A public blockchain is a shared database of all past transactions,” says Andreas Schindler, our resident blockchain expert, who looks after Business Intelligence & Innovation Scouting in our IT Healthcare division.

“Plenty of participants have a copy of this database, so no one can just revert a transaction or make a change in the database as the rest of the community would say, ‘Your version of the blockchain is not correct, it doesn’t match with ours’.”

Spreading the blockchain across a network of computers in this way makes the information it contains incredibly difficult to manipulate. With blockchain, there isn’t a single, definitive account of events that can be tampered with. Instead, an intruder would need to manipulate the majority of all blockchain copies on the network at the same time. This is what is meant by blockchain being a ‘distributed ledger’.



BETTER SUPER-SAFE THAN SORRY

As well as its distributed nature, there are other mechanisms in the blockchain that protect it against manipulation. First, new blocks are always stored linearly and chronologically. So, they are always added to the end of the blockchain.

After a block has been added to the end of the blockchain, it's very difficult to go back and alter the contents of the block. This is because each block contains its own hash, along with the hash of the block before it. Because of how hash codes are created, if any information in the block is edited in any way, the hash code changes as well.

Here's why that's important to security. If a hacker attempts to edit a transaction, as soon as they make any edit, the block's hash will change. The next block in the chain will still contain the old hash, and the hacker would need to update that block in order to cover their tracks. However, doing so would change that block's hash. And the next, and so on.

This means that in order to change a single block, a hacker would need to change every single block after it on the blockchain. This would take an enormous and improbable

amount of computing power. So, once a bl added to the blockchain it becomes difficult to edit and impossible to delete.

TUNE IN FOR OUR "FUTURE TALK" PODCAST

In a tokenized world, every physical object can have a digital twin. The Internet of Things is transforming the world we live in and there's an urgent need to ensure digital trust, and tokenize the world. Listen, how this could work.

LISTEN IN NOW!

SECURITY FOR THE SUPPLY CHAIN

You may still be wondering what this has to do with counterfeit drugs – or, in fact, any other counterfeit goods. Well, while blockchain is most well-known for storing financial transactions – as in the case of Bitcoin – this is not the only type of transaction it can host.

For example, transaction types such as shipping information and temperature data can be entered into the blockchain.

“The interesting thing is that you can always trace back any transaction in the blockchain to its origin,” explains Schindler. “Let's say I had a token and I hand it over to someone and then they hand it over to the next person and so on, everybody along this chain can always trace back the token to me. And this makes it very relevant when thinking about how the supply chain works.”

So, if a pharmaceutical supply chain was b[illegible]round and tracked with a blockchain, every time a drug was touched from creation to shipment, registration in storage, and the sale, each transaction would be entered and tracked in the blockchain. This would provide a wholly transparent tracking system for drug validity.

With the transparency provided by a blockchain, participants within the supply chain would also be incentivized to do better testing, provide better temperature control, and ensure the validity of their drugs. This is because the blockchain tracking system would give immediate tracing capability to downstream participants in the chain. So, for example, if one individual in the chain behaved fraudulently it would be easy to identify at what point in the chain this fraudulent behavior occurred.

"If I have any product, I can attach a virtual token to it, which is stored in a blockchain," Schindler explains. "Then the product can only be delivered together with this token. So, let's say a company produces 100 units of a product which all have a virtual token stored in a blockchain. They're passed onto the wholesaler, for example, and this transaction is stored in the blockchain. And then the wholesaler passes it on to another distributor – and again this transaction is stored.

"If the distributor fraudulently adds copies of the product so he has, for example, 200. It would be easy to see on the blockchain that only 100 were produced, and the fraudulent copies wouldn't have a token associated with them. Any receiver of those packages could, therefore, question the fake products' validity very easily. And the original company could also rethink who they're working with – to ensure the fraudulent distributor is cut from their supply chain."

This visibility and ability to track products would not only keep the supply chain genuine but could allow pharmacists, or even patients, to look at the supply chain data themselves, providing confidence in their medicines.

THE CURE FOR COUNTERFEIT DRUGS?

"I think the biggest challenge to creating something like this in the pharmaceutical supply chain is the mindset shift needed," says Schindler. "Researchers, academia, drug manufacturers and all the distributors in their supply chain networks would need to work together. And that's a big change from how we operate today."

That's not to say that it's impossible, of co Indeed, Schindler believes fighting counterfeits is only the start of what blockchain could achieve through creating 'digital trust'.

"I genuinely believe this is the true future of blockchain," Schindler enthuses. "It's not about cryptocurrency, it's about creating trust digitally between partners. Imagine digitally building a trust level between partners and creating an enforced honesty between all participants in the process. Insurance fees, contract costs, and other expenses could be reduced dramatically. Hacking risks could also be reduced and data security increased. Blockchain could be a solution to many challenges. And in the case of combating drug fraud, it could even be life saving."

OUR CONTRIBUTION

In 2012, the United Nations set out 17 Sustainable Development Goals (SDGs) that meet the urgent environmental, political and economic challenges facing our world. Three years later, these were adopted by all member states. We are committed that our work will help to achieve these ambitious targets. Developing secure supply chains fits under 'Goal 9 — Industries, innovation and infrastructure; Target 9.1 — Develop quality, reliable, sustainable and resilient infrastructure.' By creating unique digital signatures for products and tracking them using tamper-resistant blockchain technology, we can increase the certainty that medicines reaching patients are genuine, and not potentially ineffective – or even harmful – counterfeits.

LEARN MORE ABOUT SDGS

References:

[1] https://www.who.int/news-room/fact-sheets/de standard-and-falsified-medical-products
[2] https://www.ajtmh.org/content/journals/10.4269/ajtmh.18-0981#html_fulltext
[3] https://www.pharmaceuticalprocessingworld.com/keeping-counterfeit-medicines-out-of-the-supply-chain/
[4] https://www.strategyand.pwc.com/gx/en/insights/counterfeit-pharmaceuticals.html