Bitcoins, Blockchains, & Bioinformatics

Information, interaction, and innovation frictions have limited our nation's healthcare delivery system. Patients and providers may not have access to all the information required; the information may be incorrect; and the information is susceptible to security breaches. Health plans, managed care organizations, health systems, physicians, diagnostic facilities, ancillary providers maintain separate data ledgers for the same patient, with each entity having different regulatory standards for record-keeping. More importantly, since these data are not stored in in one easily accessible location, the net result is increased administrative burdens, expensive reconciliation processes, delay in care, and avoidable medical errors. Earlier this month, healthcare industry giants announced their foray into a blockchain pilot, tentatively to start this spring. However, long before this prospective launch, Hardesty Healthcare Solutions has been advising a start-up healthcare company on applying the blockchain for chronic disease management, healthcare quality measures, HIPAA compliance, risk-adjustment payment policies, and federal mandates for accuracy in patient data. The company got all of its start-up funding from an Initial Coin Offering (ICO) with Bitcoins. Join us as a curmudgeonly surgeon with a penchant for alliteration tries to wrap his head around bitcoins, blockchains, and bioinformatics!

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Aloke Mandal, M.D., Ph.D.
Hardesty, LLC

Aloke Mandal, M.D., Ph. D. is a Clinical Research and Medical Practice Liaison in the Healthcare practice of Hardesty, LLC. Aloke leads our Medical & Physician Consulting Practice initiative. Prior to joining Hardesty, Aloke was a medical director at Optum, a leading healthcare services company, and a nationally renowned academic transplant surgeon, general surgeon, and surgical oncologist. He provides a unique blend of clinical and healthcare business acumen required for developing population health management and value-based contracting. His recent paper on alternative payment models in Medicare Advantage has received considerable attention in Congress and among healthcare industry leaders.

Dr. Mandal was part of the team that pioneered laparoscopic live donor nephrectomy, a procedure that greatly has reduced the disincentives for live kidney donation. Because of that role, he has appeared on the cover of U.S. News & World Report. He has over 40 peer-reviewed research articles, conference papers, and book chapters. Hence, he also provides clinical input and clinical research oversight when working with venture capital, medical device, biopharmaceutical, and life sciences firms for emerging biomedical technologies.

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Bitcoins, Blockchains, & Bioinformatics

Aloke K. Mandal, M.D., Ph.D.
Clinical Research & Medical Liaison, Hardesty Healthcare Solutions
Partner, Hardesty LLC

What is a Bitcoin?

Cryptocurrency: Criteria (Advantages/Disadvantages)

- The system does not require a central authority, distributed achieve consensus on its state. (No Central Bank.)

- The system keeps an overview of cryptocurrency units and their ownership.

- The system defines whether new cryptocurrency units can be created. If new cryptocurrency units can be created, the system defines the circumstances of their origin and how to determine the ownership of these new units.

- Ownership of cryptocurrency units can be proved exclusively cryptographically. (Anonymity)

- The system allows transactions to be performed in which ownership of the cryptographic units is changed. A transaction statement can only be issued by an entity proving the current ownership of these units.

- If two different instructions for changing the ownership of the same cryptographic units are simultaneously entered, the system performs at most one of them.
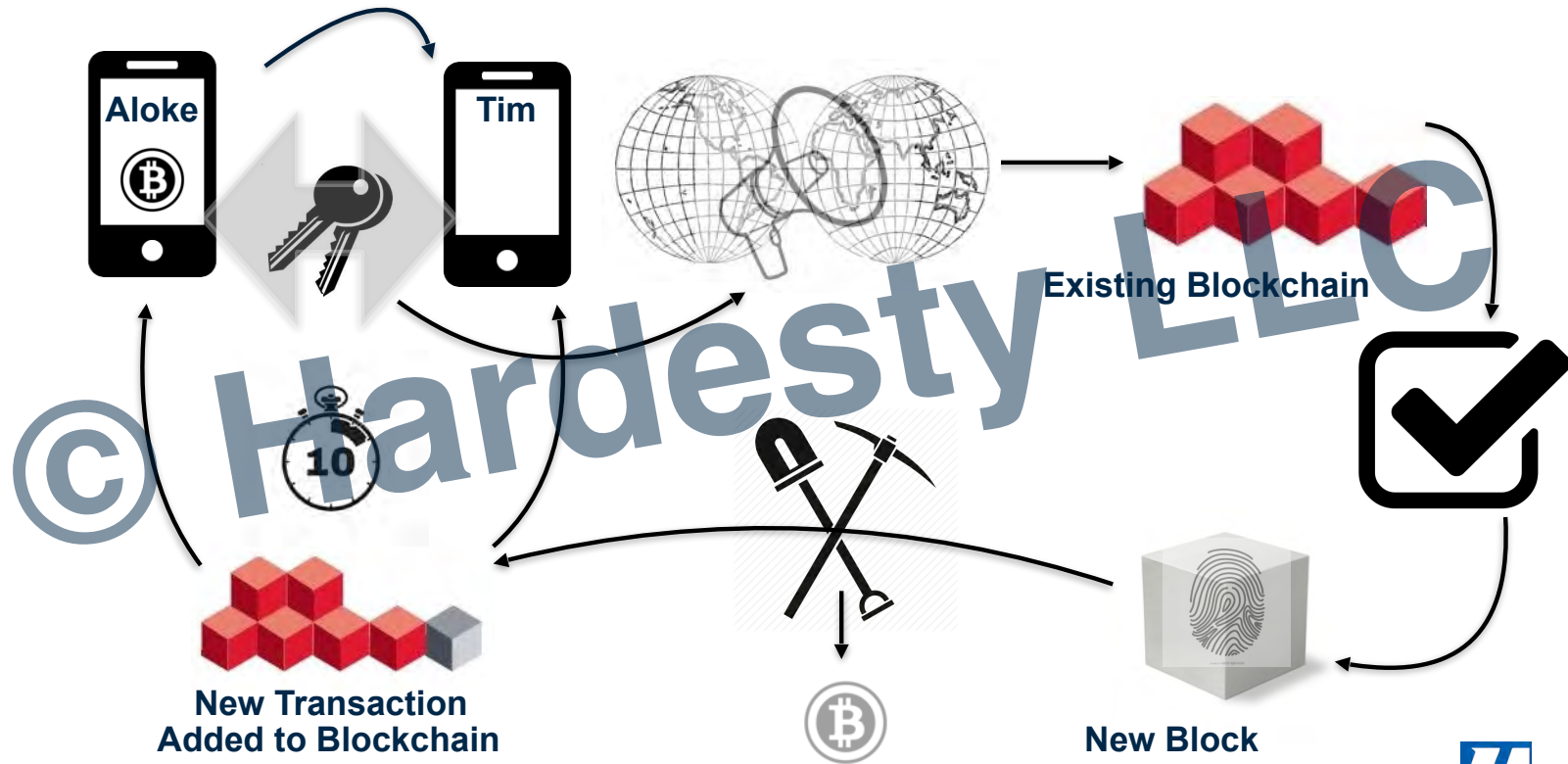
How to Get Bitcoins…

- **Buy them on an Exchange**
- **Acquire them transactionally for goods and services**
- **"Mining" for Bitcoins**
    - **Verify the transaction**
    - **Need to verify more than just the one transaction**
    - **All the transactions are verified are gathered into a blockchain.**
    - **The transactions are locked.**
    - **Miners must find the correct key to unlock it.**
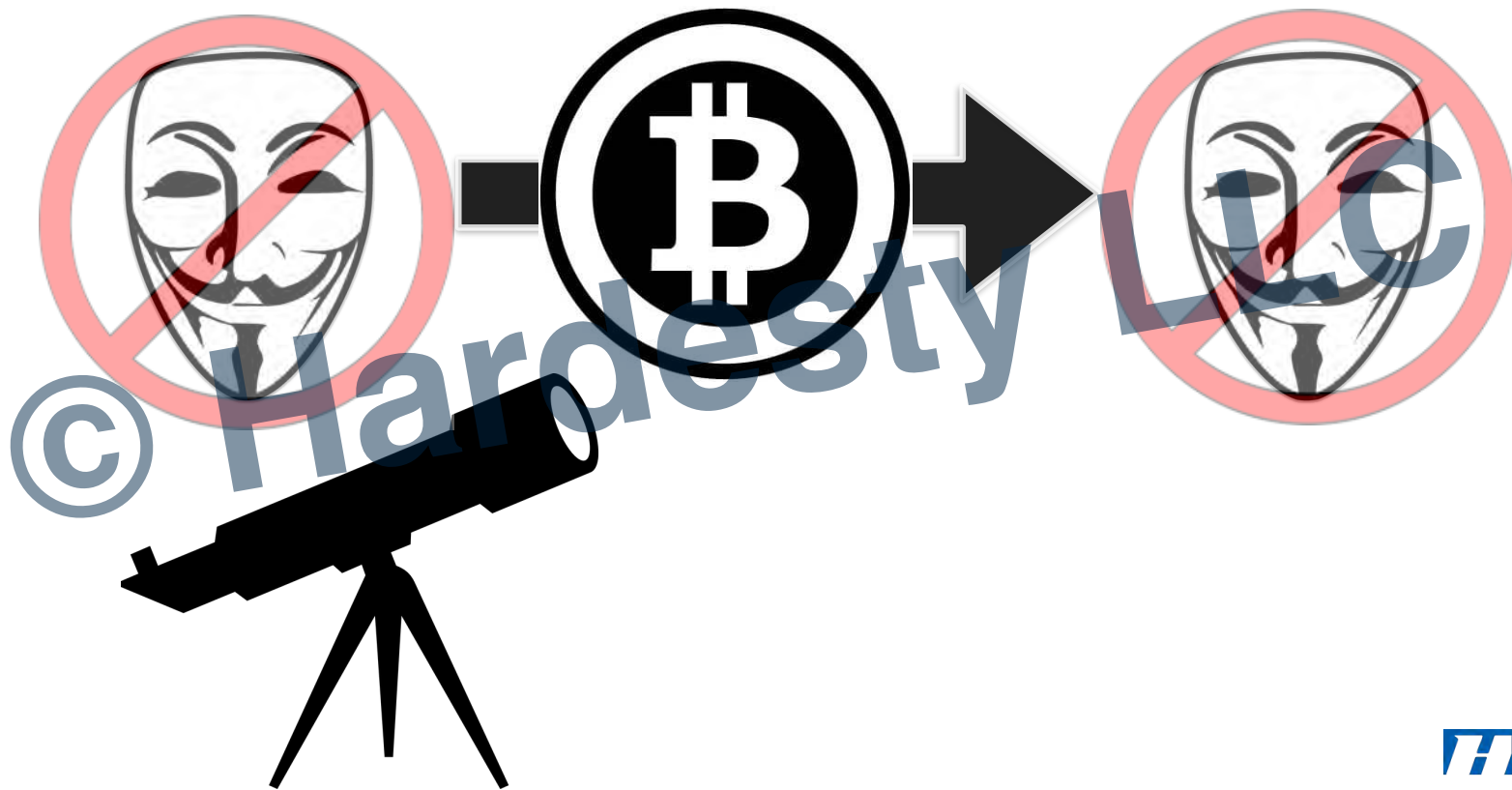- **No "TRUST" issues !!!???!!!**

What's Does the Bitcoin Blockchain Work?

Aloke

Tim

Existing Blockchain

New Transaction
Added to Blockchain

New Block

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Bitcoin Blockchain: Shared Public Ledger with Anonymity

Why Would A Law-Abiding Citizen Use Bitcoins?

- **Universal Currency - International Purchases**
- **Non-inflationary - Only 21 million bitcoins**
- **No Capital Controls**
- **Secure Payments**
- **Faster than Electronic Currency, Credit Cards**
- **Initial Coin Offering (ICO) versus Initial Public Offering (IPO)**
  - **An ICO is a fundraising vehicle, typically for start-ups. Investors send some form of cryptocurrency (i.e. Bitcoin) to the company. In exchange, they get an entirely new cryptocurrency.**
  - **Advantage/Disadvantage #1: An ICO is a lot like an IPO, but instead of getting shares in return, investors get digital assets, called tokens. No equity stake or voting rights in the underlying company.**
  - **Advantage/Disadvantage #2: Limited regulation. There is no dedicated "ICO regulator."**

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What is a Blockchain?

Continuously growing list of records, called blocks, which are linked and secured using cryptography.

- Each block typically contains a cryptographic hash of the previous block, a timestamp and transaction data.

- By design, a blockchain is inherently resistant to modification of the data.

- An open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way.

- Once recorded, the data in any given block cannot be altered retroactively without the alteration of all subsequent blocks, which requires collusion of the network majority.

- Decentralized consensus has therefore been achieved with a blockchain. This makes blockchains potentially suitable for the recording of events, medical records, identity management, transaction processing.

What is a Blockchain?
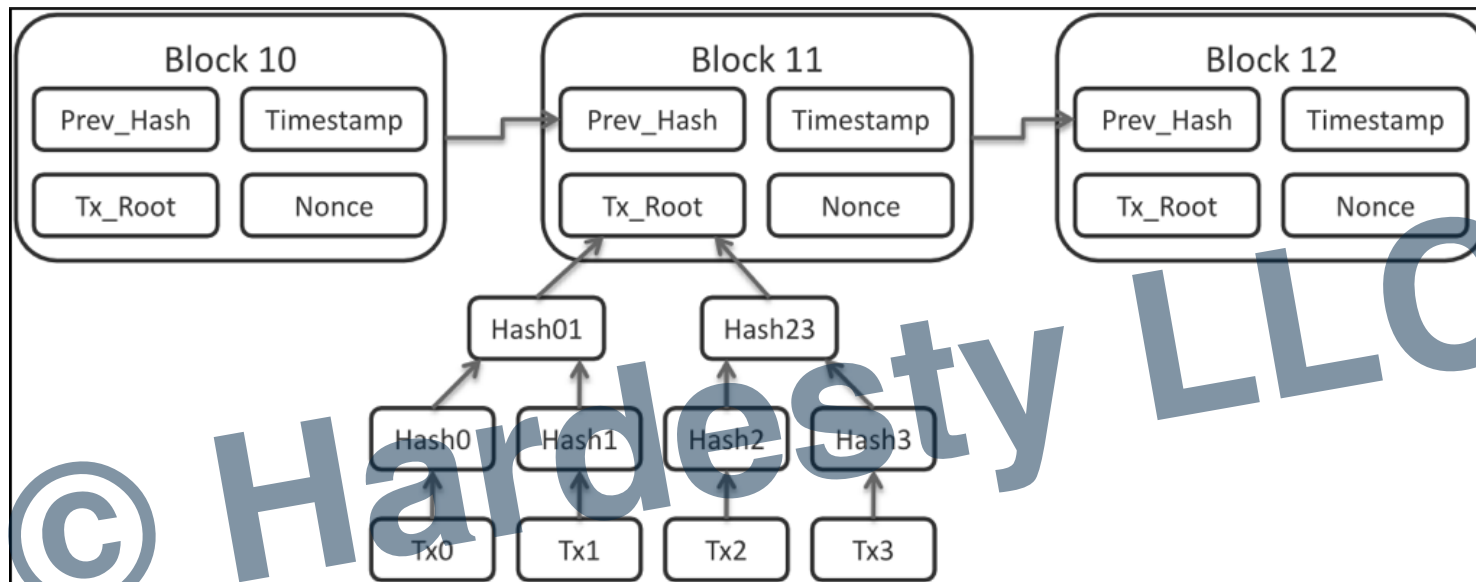
Hash: Unique Identifier, each Block is linked to the Hash of the Previous Block
Nonce: Used only once
Timestamp
Tx_Root: "Merkel Root"
Merkel Tree:

What is Not a Blockchain?

It is NOT an encrypted central database.

Blockchains ARE distributed ledger

- **All Transactions are recorded**

- **Transactions cannot be modified, inserted between existing blocks, or deleted**
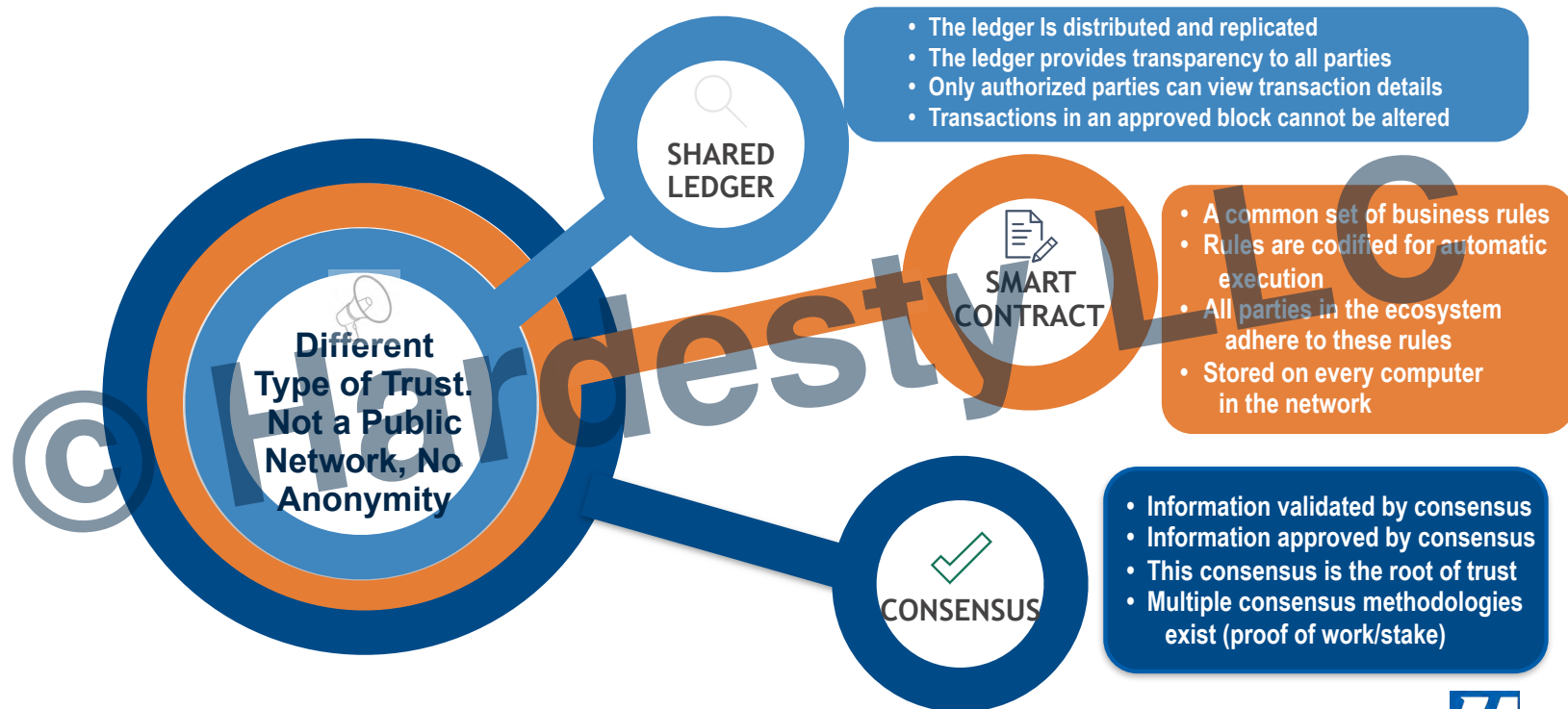
- **Ledger can be appended, never amended**

Bitcoin Blockchain & Other Blockchains

	Bitcoin	Ethereum	Hyperledger
Cryptocurrency Use	Bitcoin	Ether or user-created	None
Network Types	Public	Public or permissioned	**Permissioned**
Transaction Types	Anonymous	Anonymous or private	**Public or confidential**
Consensus Mechanism	Proof of work	Proof of work	Practical Byzantine Fault Tolerance (PBFT) and/or Proof of Stake
Smart Contracts	None	Yes (Solidity, Serpent, LLL)	Yes (Chaincode)
Programming Language	C++	Golang, C++, Python	Golang, Java

Fundamental Elements of a Healthcare Blockchain

SHARED LEDGER
- The ledger Is distributed and replicated
- The ledger provides transparency to all parties
- Only authorized parties can view transaction details
- Transactions in an approved block cannot be altered

SMART CONTRACT
- A common set of business rules
- Rules are codified for automatic execution
- All parties in the ecosystem adhere to these rules
- Stored on every computer in the network

CONSENSUS
- Information validated by consensus
- Information approved by consensus
- This consensus is the root of trust
- Multiple consensus methodologies exist (proof of work/stake)

Different Type of Trust. Not a Public Network, No Anonymity

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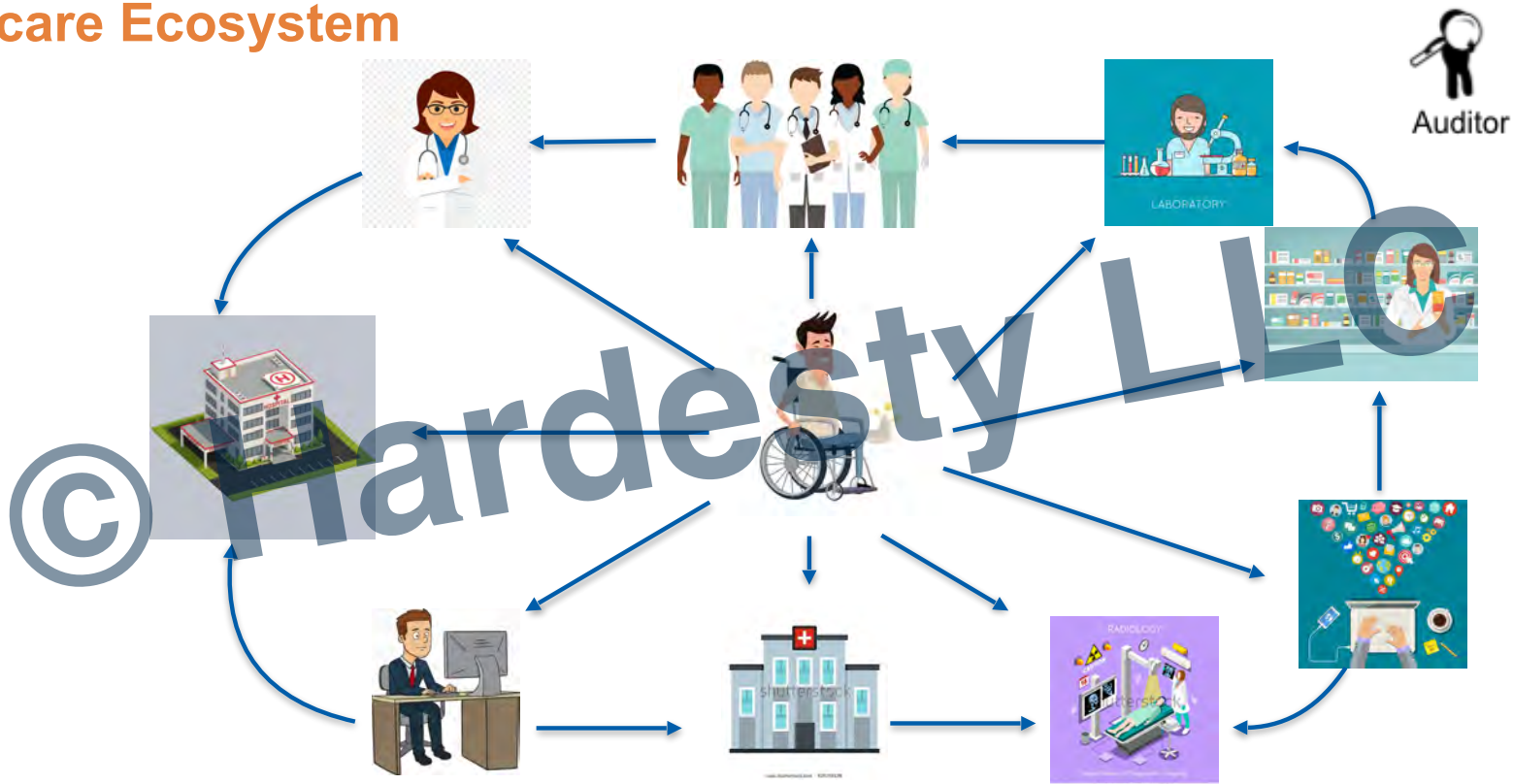Top line talent - Bottom line results

What is Bioinformatics?

For the purpose of this talk, it's JUST an Alliterative Device.

"The science of collecting and analyzing complex biological data such as genetic codes"

Healthcare Ecosystem

Healthcare: Current State of Affairs

- Population Health Management/Evidence-Based Medicine:

  - "Congestive heart failure (CHF) is the most common reason for admission of Medicare patients to a hospital. Sadly, 40% of Medicare patients discharged after admission for CHF are readmitted within 90 days, even though well-designed demonstration projects have shown for years that that rate can be reduced by more than 80% with proper management of patients…a prime example of what goes wrong when a health care system lacks the capacity to integrate its work over time and across sites of care."

  - Health Insurance *Portability* and *Accountability* Act of 1996 (HIPAA)

  - 2016: 407 Breaches, 27.3 Million Records (averaging $355 per record)

  - 2017: 477 Breaches, 5.6 Million Records (averaging $380 per record)

- Electronic Health Records/Billing:

  - Billing and Insurance Related costs expected to reach $315 Billion in 2018

  - Medical offices spending 3.8 hours each week interacting with payers

"Friction" in Healthcare

TYPES OF FRICTION

Information Friction

- **Is the information accessible to all?**
- **Is the information accurate?**
- **Is the information secure?**

Interaction Friction

- **Cost of Conducting Business**
- **Degrees of Separation**
- **Pre-authorizations**

Innovation Friction

- **Bureaucracy**
- **Regulations**
- **New Technologies**

BLOCKCHAIN "GREASE"

Shared Ledger

- **Append-only distributed system of record shared across the network.**

Permissions

- **Ensuring appropriate visibility**
- **Transactions are secure, authenticated, & verifiable**

Smart Contracts

- **Algorithms are embedded in the transaction database and executed with transactions**

Consensus

- **Proof of Work, Proof of Stake**
- **All Parties Verify Transactions**

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Strengths, Weaknesses, Opportunities, & Threats

- **Decentralization and shared distribution among transactional partners creates a single source for disparate data**
- **Permanent and highly fault tolerant data**
- **Gather data from many sources**
- **Securely share information**

- **No interoperability between blockchains**
- **Huge amount of computing power required for supporting large blockchains**
- **Unknown if sufficient privacy for financial or health records**

- **Eliminate transactional inefficiencies**
- **Reduce dependence on data middlemen**
- **Greater access for healthcare analysis**

- **Security breach of an individual record if key is hacked**
- **Unconscious patient can't share key**
- **Not fully using technology since most usage is "blockchained databases"**

Optum, UnitedHealthcare, Humana: A Very Limited Application

"Five healthcare organizations including insurers UnitedHealthcare and Humana, Optum, Quest Diagnostics and MultiPlan are launching a blockchain pilot to help payers tackle mandated provider directories."

"The program will apply blockchain technology to improve the quality of data and reduce the administrative costs associated with insurers getting up-to-date healthcare provider demographic data."

Cleary, their proof-of-concept is as a blockchain database!

Healthcare IT News

TO

Optum, UnitedHealthcare, Humana, others launch blockchain pilot

The alliance is one of the first, if not the first, national blockchain alliances for healthcare, says Optum engineer.

By Susan Morse | April 02, 2018 | 10:28 AM
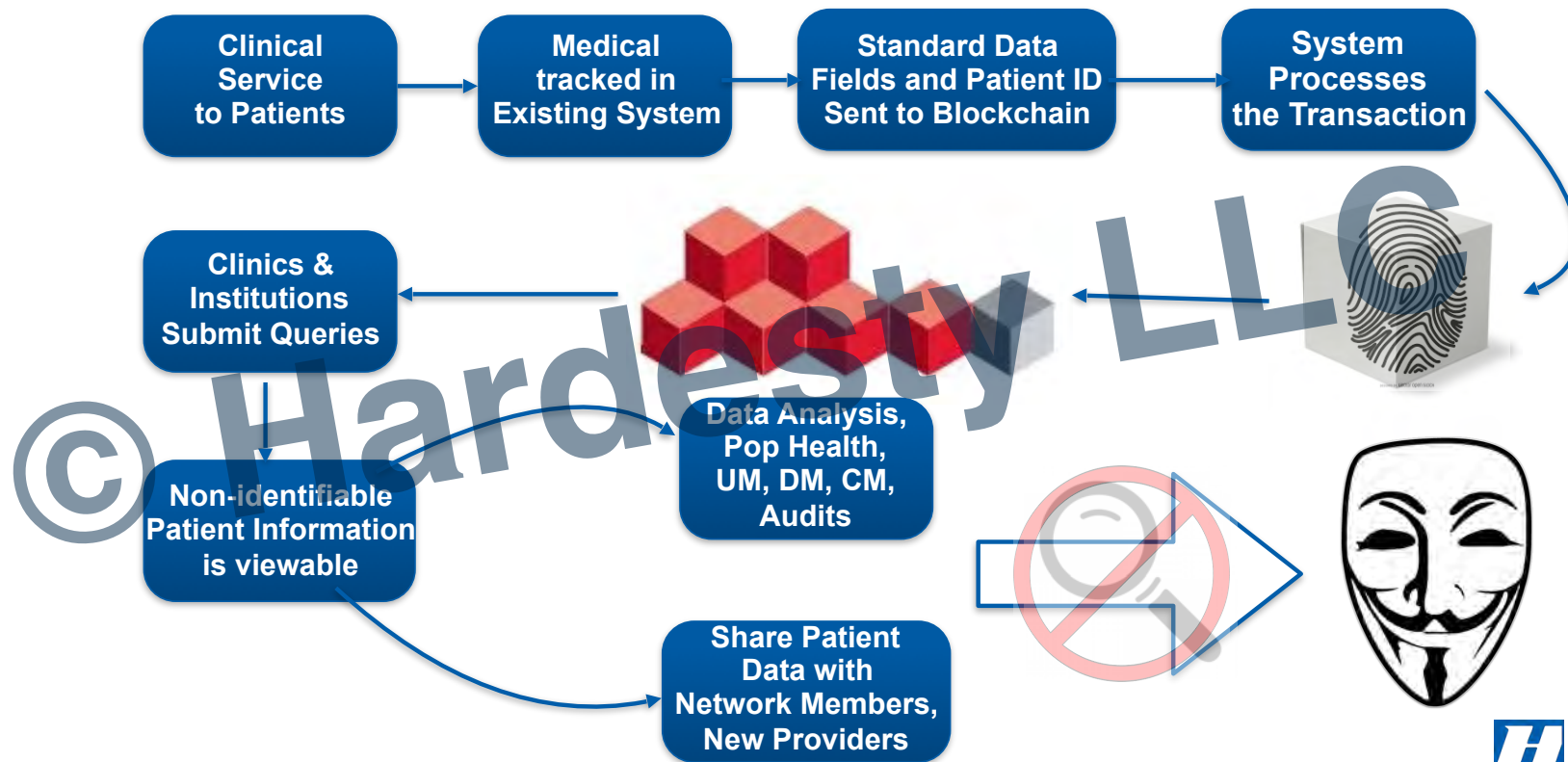
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What is Hardesty Healthcare Solutions Doing with the Blockchain?

- **CFO Partner: Initial Coin Offering**

  - **Raised $7.2 Million in 3 Days**

    - **Anyone can acquire its tokens (native cryptocurrency) at a discount rate by pledging Ether (ETH) into the token sale smart contract.**

- **Proof of Stake: All Members of the Network Use Its Tokens**

  - **The token is the fuel for driving the blockchain infrastructure. The primary usage of the token is to regulate network storage allocation, health care quality measures, and revenue payment cycles.**

  - **Patients are given an allotted amount of space to store information for free on the Patientory network. The token allows them to purchase extra storage space from nodes set up in hospital systems. Tokens can be purchased via the platform or an exchange.**

  - **Healthcare organizations use tokens in this instance as well. It is also used in payments once smart contracts are executed with healthcare insurance companies and serves as a mechanism to regulate value based model metrics.**

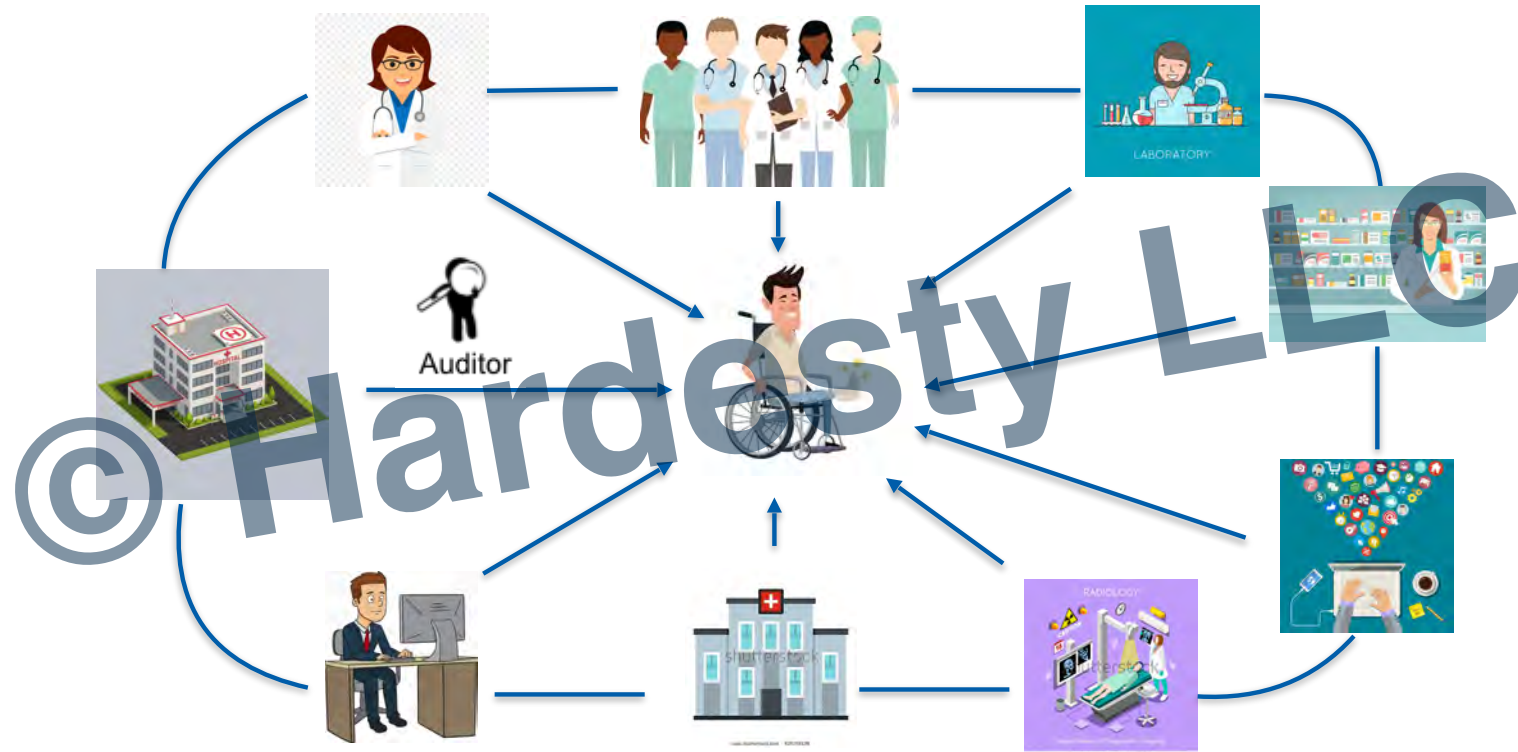- **The value of the tokens are tied to the volume of transactions executed in the network.**

Healthcare Ecosystem with the Blockchain

Does It Work? Pilot Study

- **Test Subject: Hospital System with High Incidence of CMS Penalties and Healthcare Breeches**

- **Use Tokens for:**

  - **Network Storage and Security**

  - **Smart Contracts for Value-Based Reimbursements**

  - **Smart Contracts for Claims Remittance, Audit Trails, & Pre-Authorizations**

- **Preliminary Results**

  - **0 Healthcare Breaches**

  - **85% Decrease in Hospital Readmissions & Penalties**

  - **42% Decrease in IT Expenditures**

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FUTURE Hardesty Value Proposition for Our Client

- **Value-Based Contracting Initiatives**

- **Risk-Contracting Initiatives**

- **Algorithms for:**

  - **Risk-Adjusted/Health-Based Payment Methods**

  - **Healthcare Quality Parameters**

  - **Preventable Quality Indicators**

  - **Low-Value Care Utilization**

  - **Utilization Management**

  - **Disease Management & Case Management**

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Thank You!

HARDESTY HEALTHCARE SOLUTIONS
STRATEGIC INTELLIGENCE & LEADERSHIP

Aloke Mandal, M.D., Ph.D.
Clinical Research and Medical Practice Liaison

714-335-6624 Mobile
amandal@hardestyllc.com

www.HARDESTYHEALTHCARE.com

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