

Blockchain: The Future of Healthcare Data?

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Imperial College London

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Distributed Ledgers: The Future of Healthcare Data?

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Meet the Team



Will Knottenbelt
Professor of
Applied Quant.
Analysis



Cathy Mulligan
Smart Cities
Telecoms
Government Advisor



Rob Learney
Bioengineering
Future of Medicine

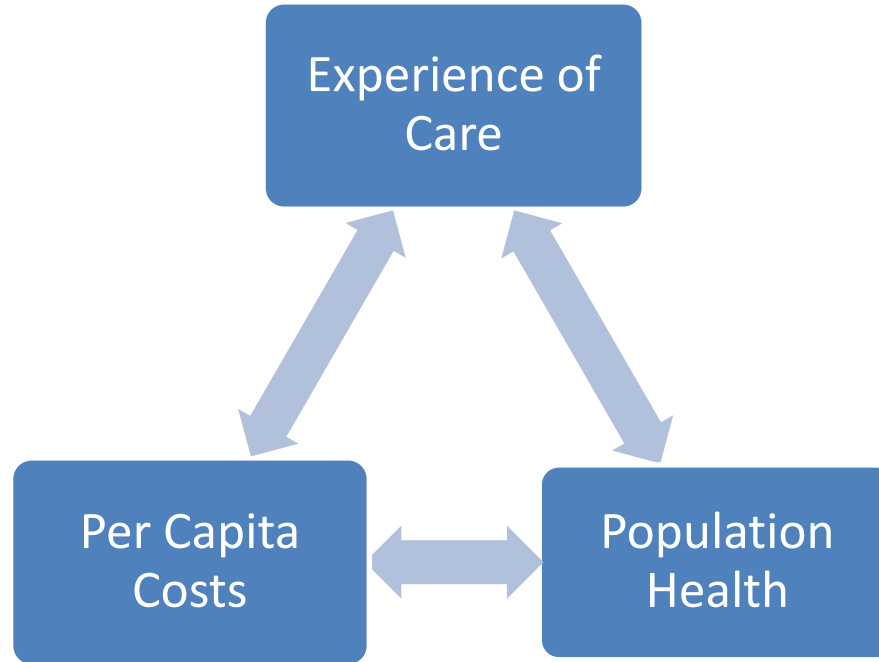


Melek Somai
Public Health
Digital Transformation

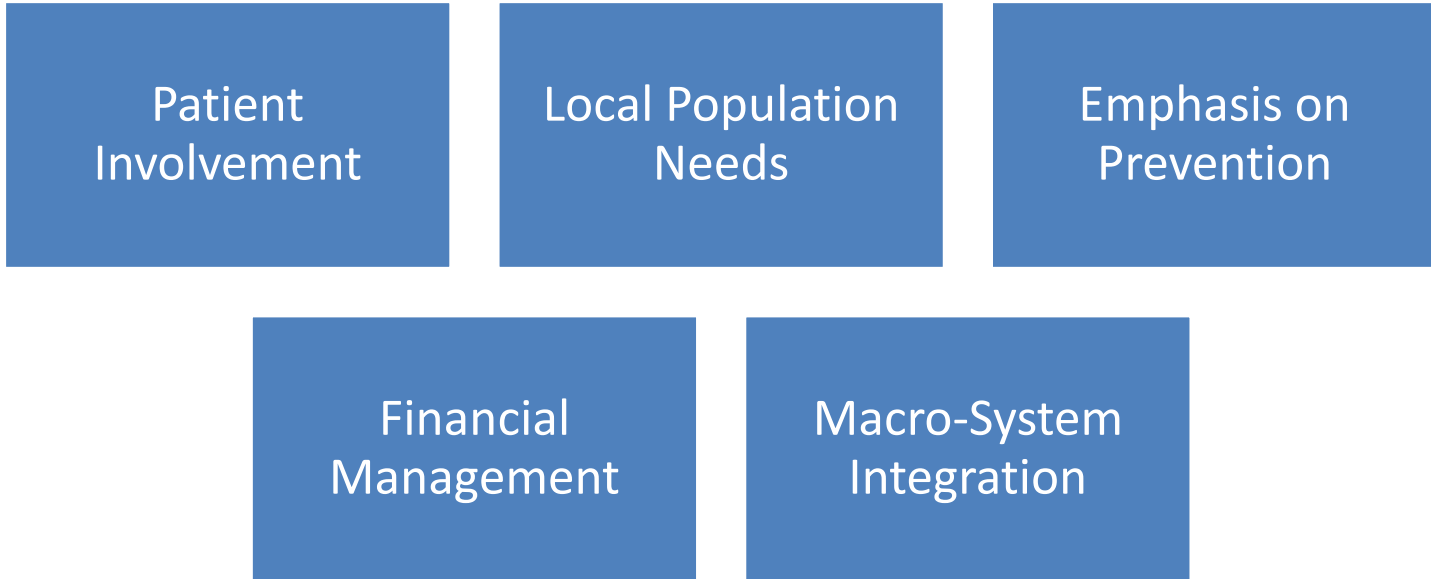


Iain Stewart
Mathematics of
Security & Scaling

Triple Aims of Healthcare



Core Elements



How to Connect the Dots?

The 'Integrator'

```
graph TD; A[The 'Integrator'] --- B[Patient Involvement]; A --- C[Local Population Needs]; A --- D[Emphasis on Prevention]; C --- E[Financial Management]; C --- F[Macro-System Integration];
```

Patient
Involvement

Local Population
Needs

Emphasis on
Prevention

Financial
Management

Macro-System
Integration



Patient
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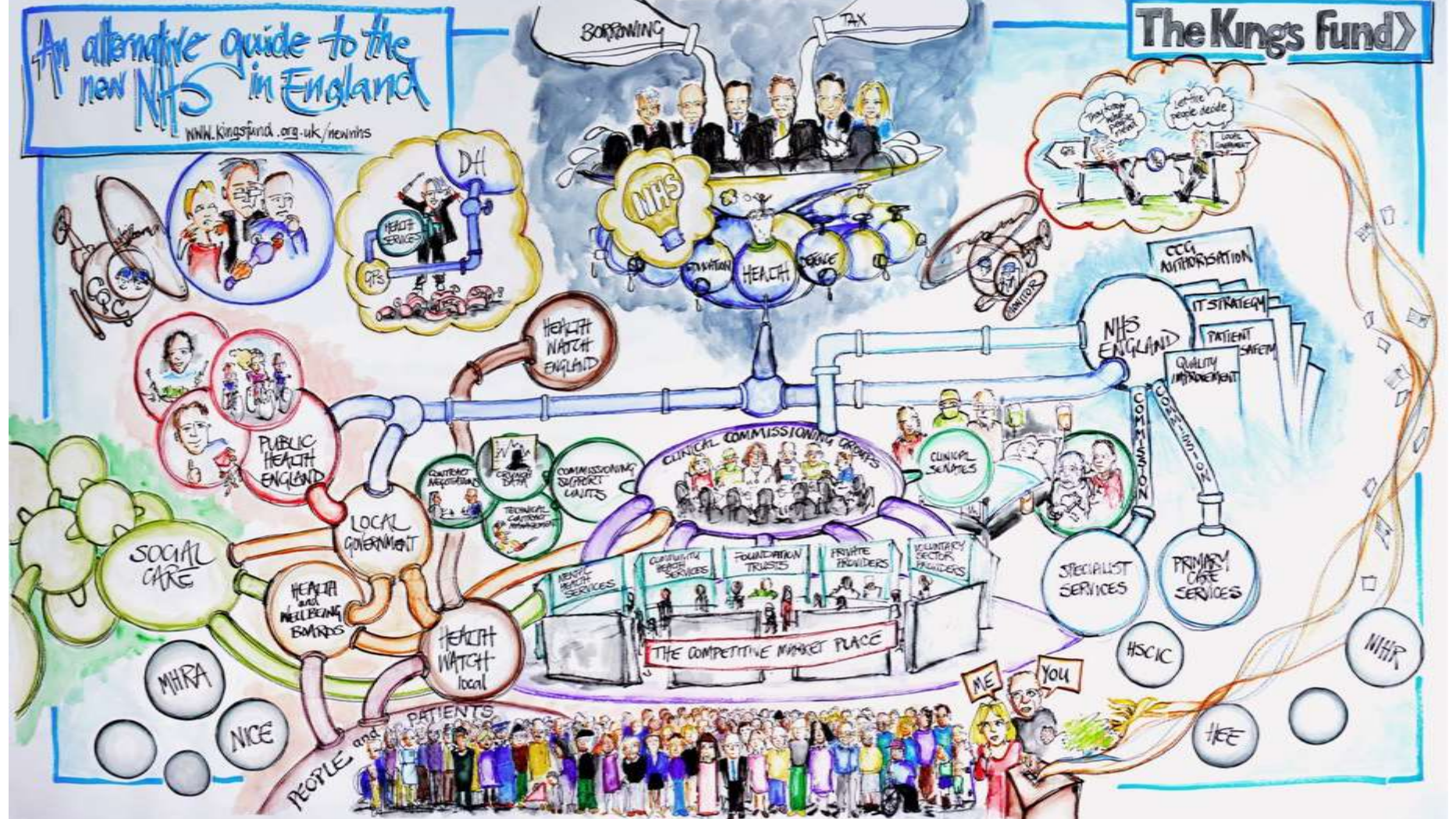
NHS

~~NIHS~~

An alternative guide to the new NHS in England

www.kingsfund.org.uk/newnhs

The Kings Fund



The 'Integrator'

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graph TD; A[The 'Integrator'] --- B[Patient Involvement]; A --- C[Local Population Needs]; A --- D[Emphasis on Prevention]; C --- E[Financial Management]; C --- F[Macro-System Integration];
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Patient
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~~The 'Integrator'~~

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Integration

The Future of Healthcare is Data

All Driven By Data

Patient
Involvement

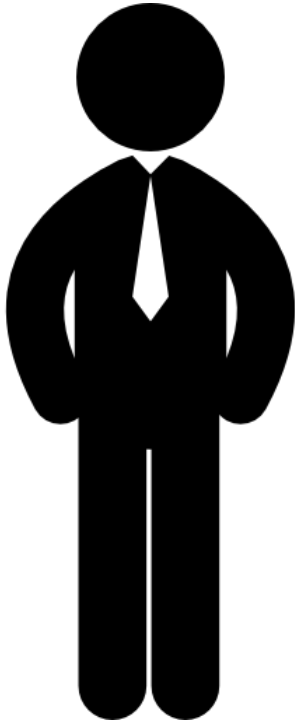
Local Population
Needs

Emphasis on
Prevention

Financial
Management

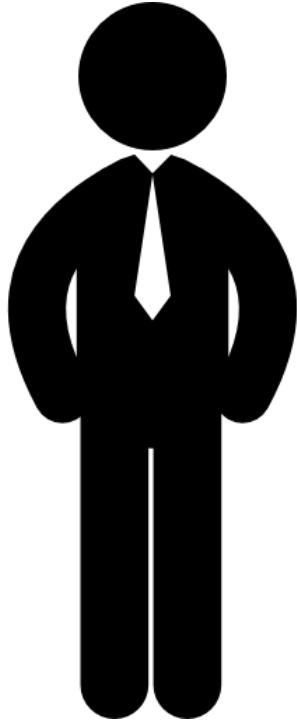
Macro-System
Integration

Imagine: Healthcare in 2027



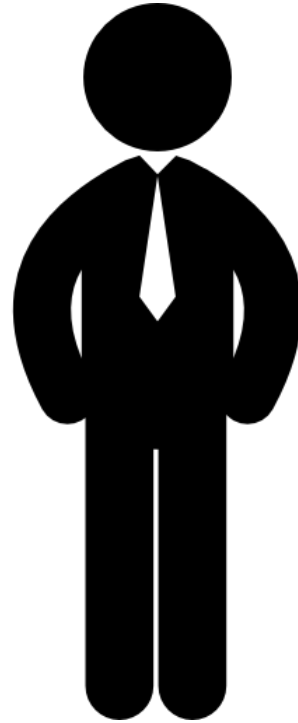
- Tony
- 26
- Married
- 1 Young Child
- Works at a Supermarket

Imagine: Healthcare in 2027

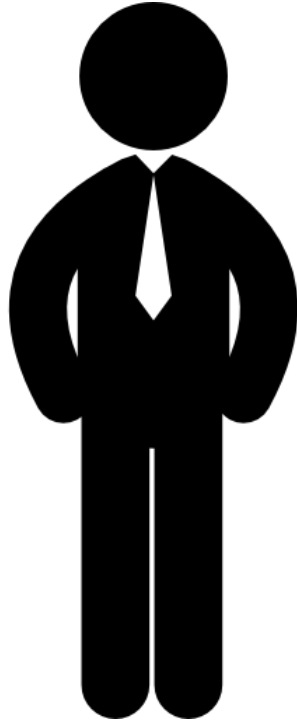


- Tony
- 26
- Married
- 1 Young Child
- Works at a Supermarket
- Severe Asthma

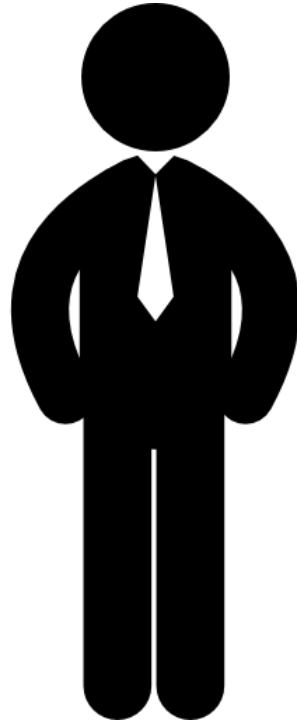
Tony's Healthcare Journey



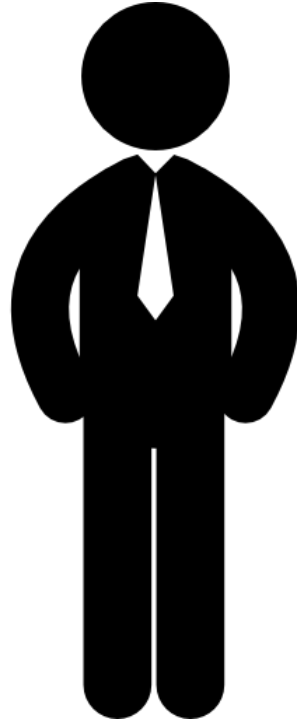
Tony's Healthcare Journey



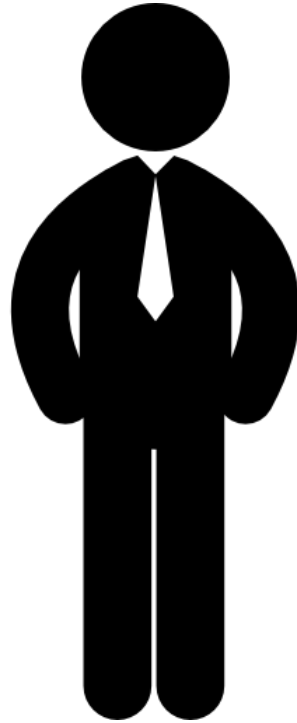
Tony's Healthcare Journey



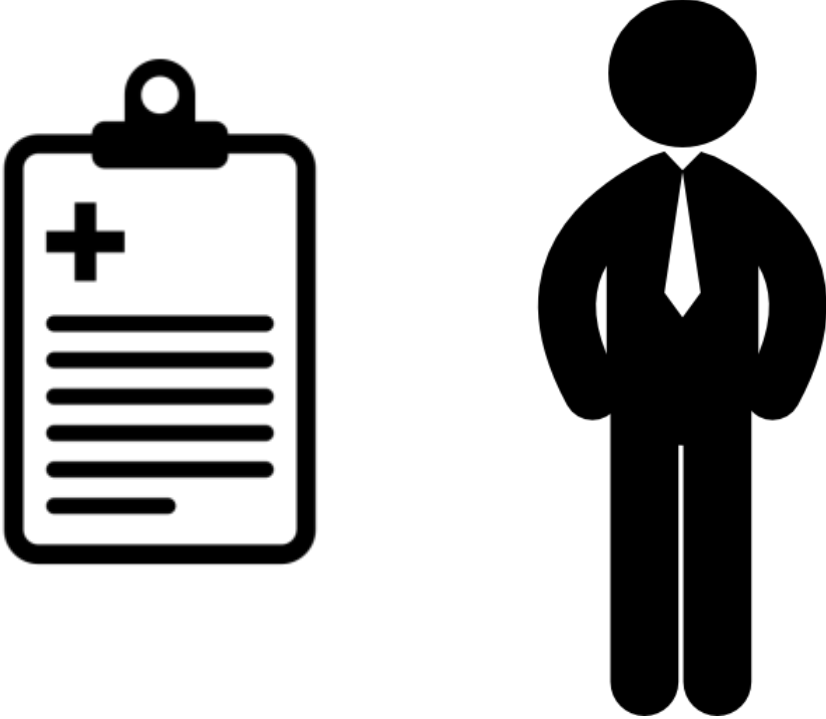
Tony's Healthcare Journey



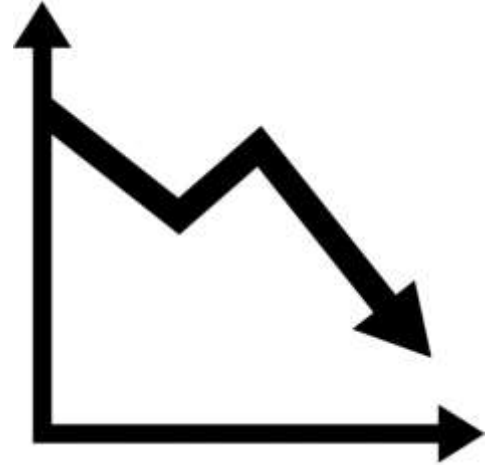
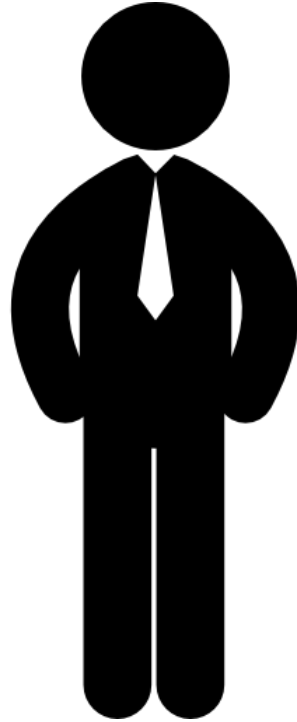
Tony's Healthcare Journey



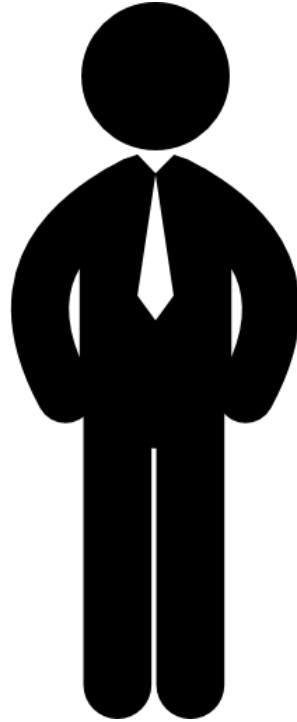
Tony's Healthcare Journey



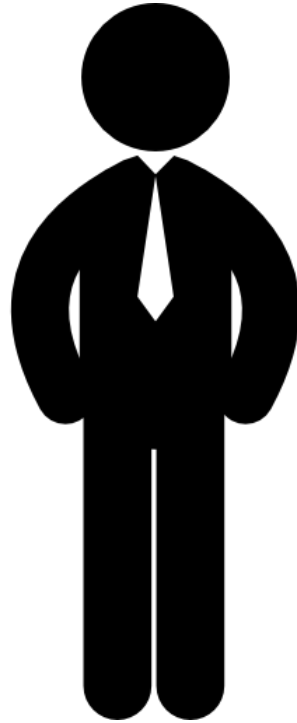
Tony's Healthcare Journey



Tony's Healthcare Journey



Tony's Healthcare Journey



Millions of Tonys

Millions of Journeys

Map 23: Rate of asthma emergency admissions to hospital in people aged 19 years and over per population by CCG

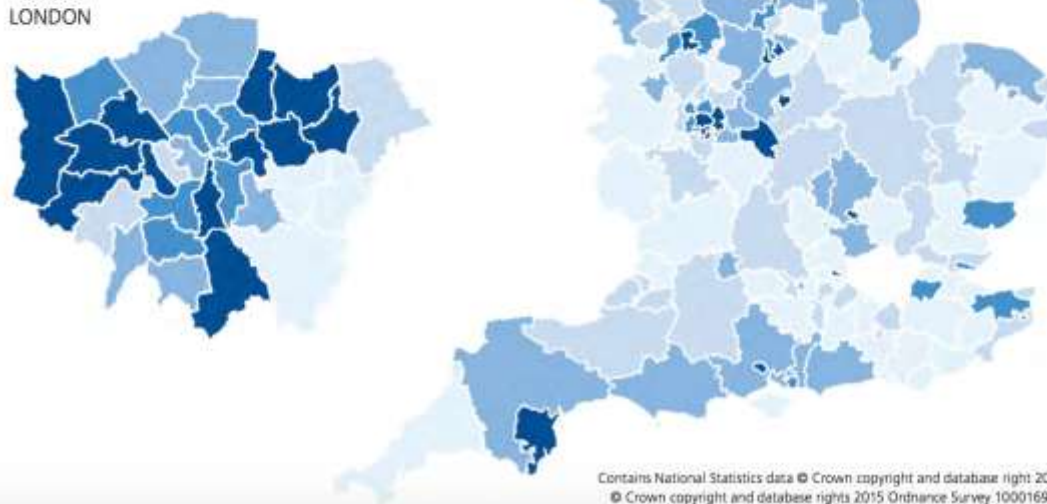
Directly standardised rate, adjusted for age and sex, 2012/13

Domain 2: Enhancing quality of life for people with long-term conditions

Domain 3: Helping people to recover from episodes of ill health or following injury



LONDON



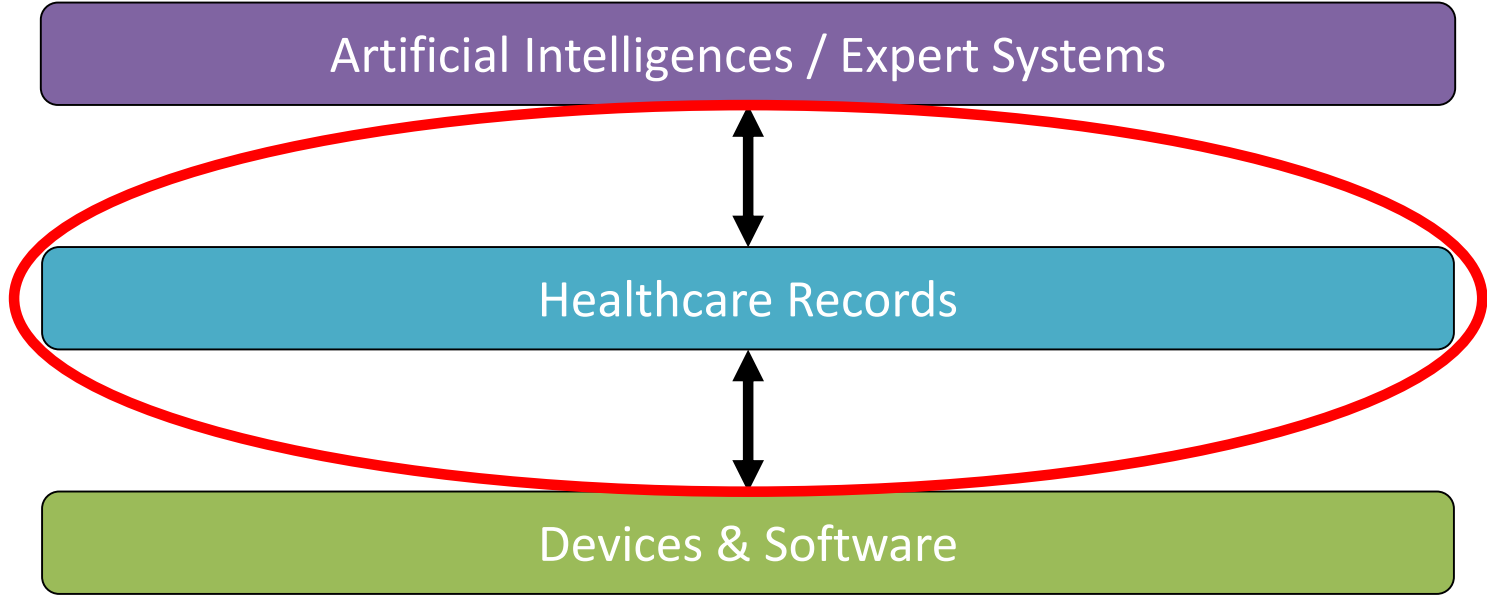
Artificial Intelligences / Expert Systems



Healthcare Records



Devices & Software



Artificial Intelligences / Expert Systems

Healthcare Records

Devices & Software

Roadblocks to Progress

- Identity Management System
- Secure Data Storage
- Secure Backup System
- Legal Compliance
- Data Formats
- Communication Protocols
- APIs



Repetition &
Reinvention

Opaque/Absent
Standards

Roadblocks to Progress

- Identity Management System
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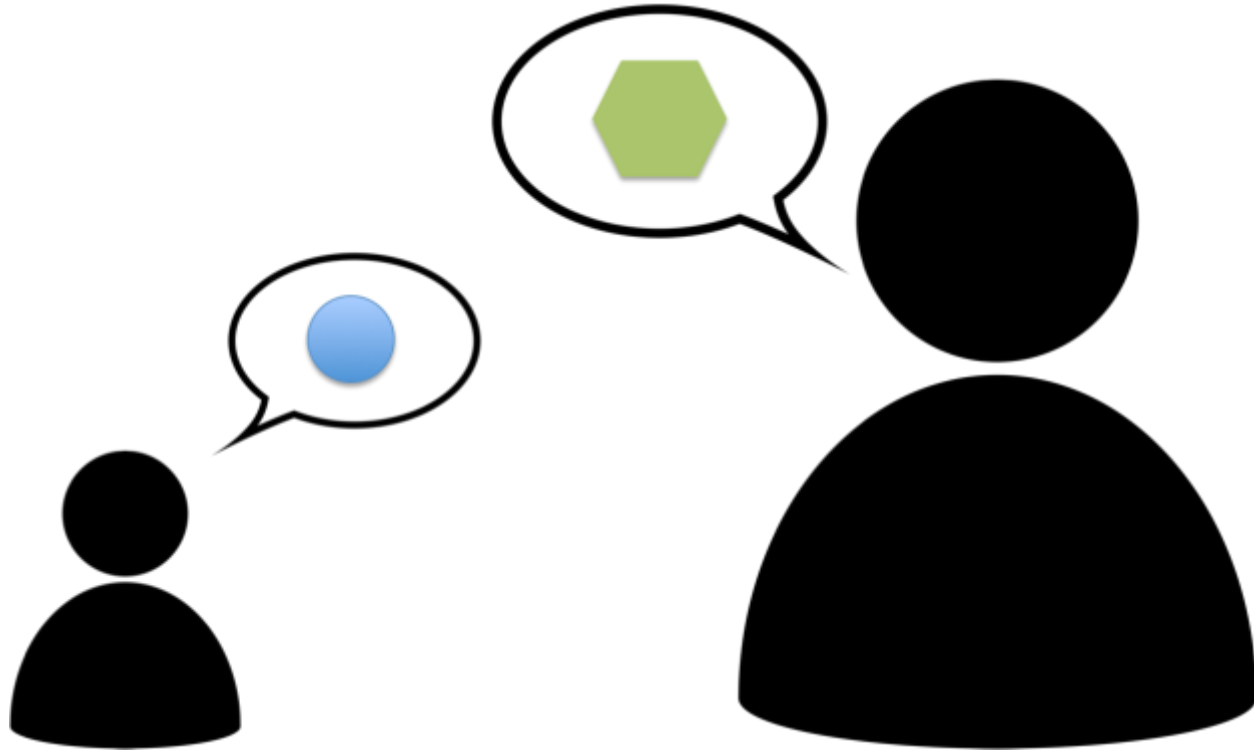


Repetition &
Reinvention



Opaque/Absent
Standards

Monopoly Pressures



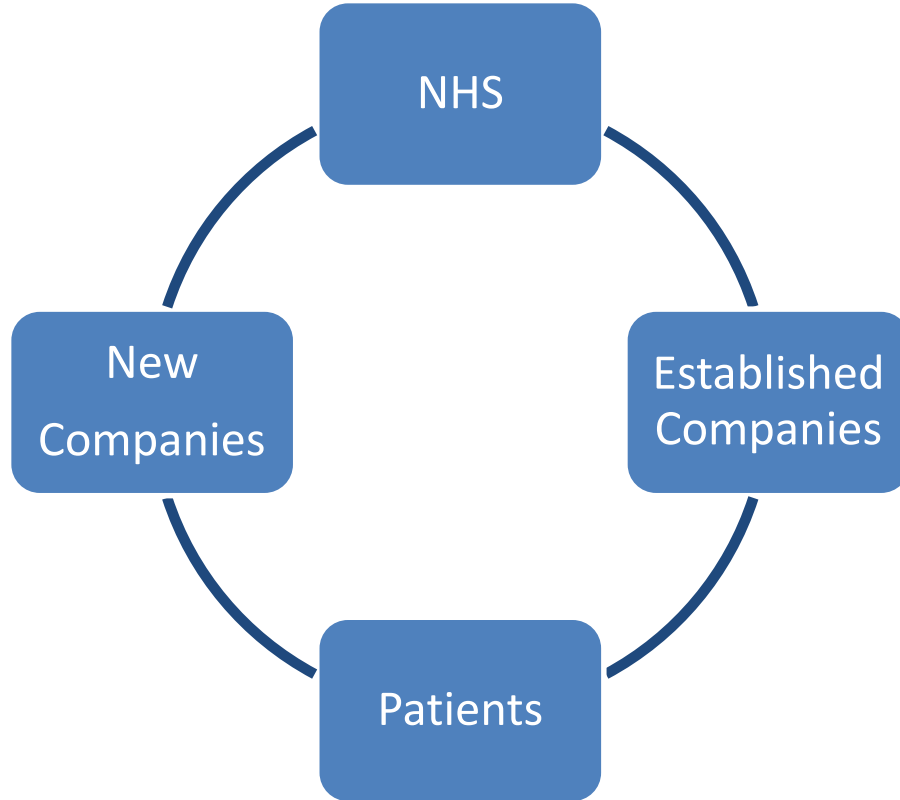


Wearable devices that track fitness are a rich source of real-time health data.

Stop the privatization of health data

Tech giants moving into health may widen inequalities and harm research, unless people can access and share their data, warn **John T. Wilbanks** and **Eric J. Topol**.

Permissionless Innovation



What is Distributed Ledger Technology?

D^r Vincent

1817

Jan 28	To sundries	10	1	6
30	" Making 10 ^{rs} shoes	5	"	"
March 19	" 2 Days Tying Hats	10	"	"
23	" Taping & mending Shoes	2	"	"
25	" Taping 2 ^{rs} shoes	2	9	"
April 5	" Mending 1 st Boot	1	"	"
26	" Taping & mending Shoes	2	"	"
May 5	" Mending 2 nd Boot	3	"	"
	" Mending 1 st Boot 1 shoe	2	5	"
		41	1	9

1817

May 27	To Balance Due	1	"	8
29	" Making 1 st Shoes	6	"	"
June 12	" Making 1 st Shoes	5	6	"
21	" Making 2 nd Shoes	5	"	"
August 9	" Taping 1 st Shoes heels	2	6	"
Oct 1	" Rate	2	"	"
4	" In Bushed Amos	4	"	"
	" 1 Day haying with Boy	9	"	"
	" 1 Day cutting Grass with Boy	8	"	"
4	" Making 1 st Shoes	5	6	"
20	" Making 1 st Shoes	5	6	"
	" Day Mending Shoes	5	"	"
24	" Mending 1 st Boot	5	"	"
28	" Mending 1 st Boot	2	"	"
Nov 10	" Mending 1 st Boot	2	"	"

Stillwill C^d

1817

Jan 28	By sundries	9	16	1
May 17	" Hoops & Plow	2	3	8
	" Balance due in account	2	11	1
		14	19	9

This day second settled all acct & find due two Dollars fifty Cts
 to Deusham May 27th 1817
 Christ Watson

Vincent Stillwill

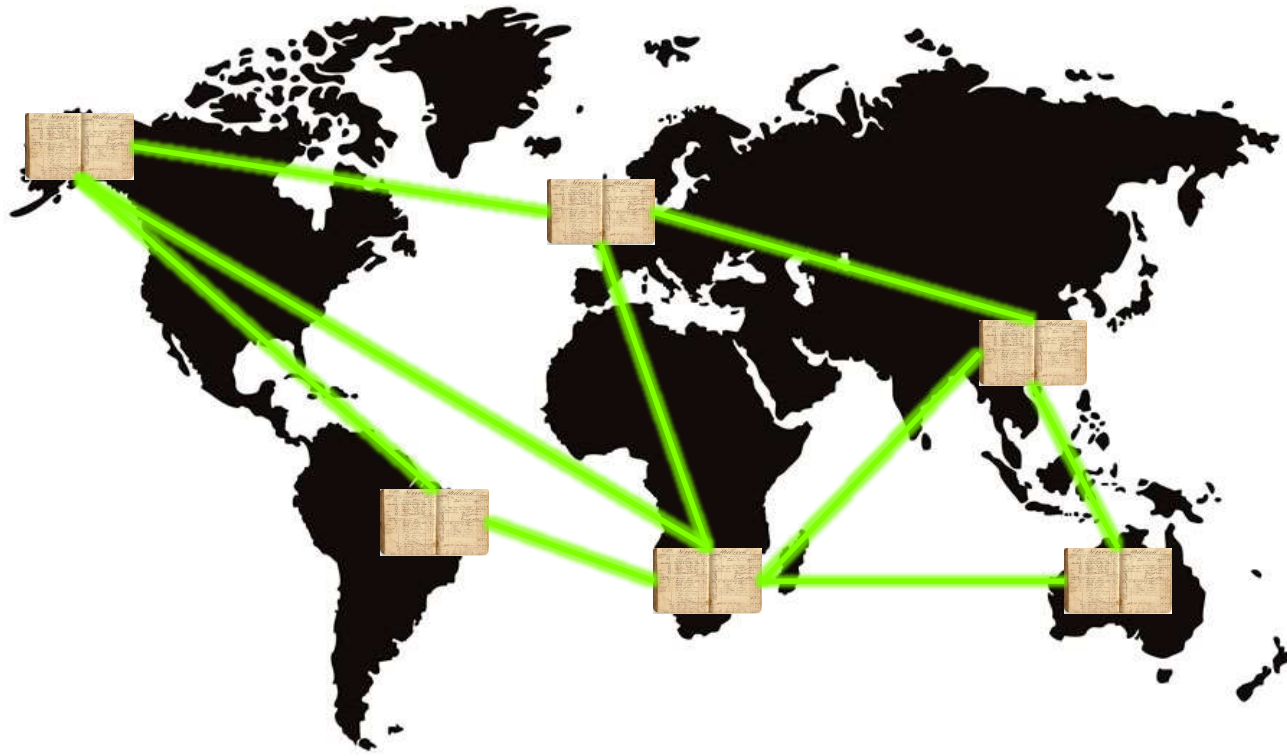
This account settled

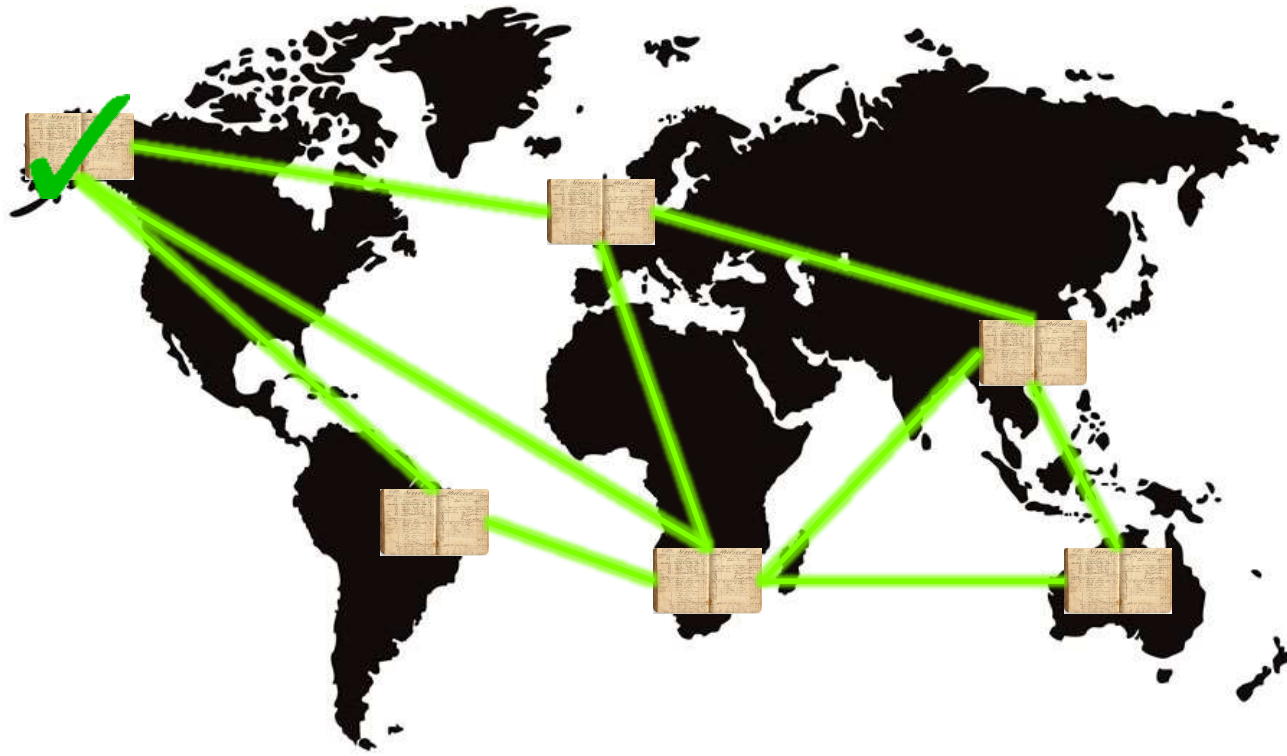
July 1	By Samuel Waffer	4	6	"
	" Hoops to Plow Corn	2	"	"
	" sundries	2	"	"
Dec 4	" Hoops & Plow	6	"	"
	" Hoops ground	1	"	"
	" Mending shoes	3	9	"
Dec 4	" & Mending what	1	"	"
		3	2	3

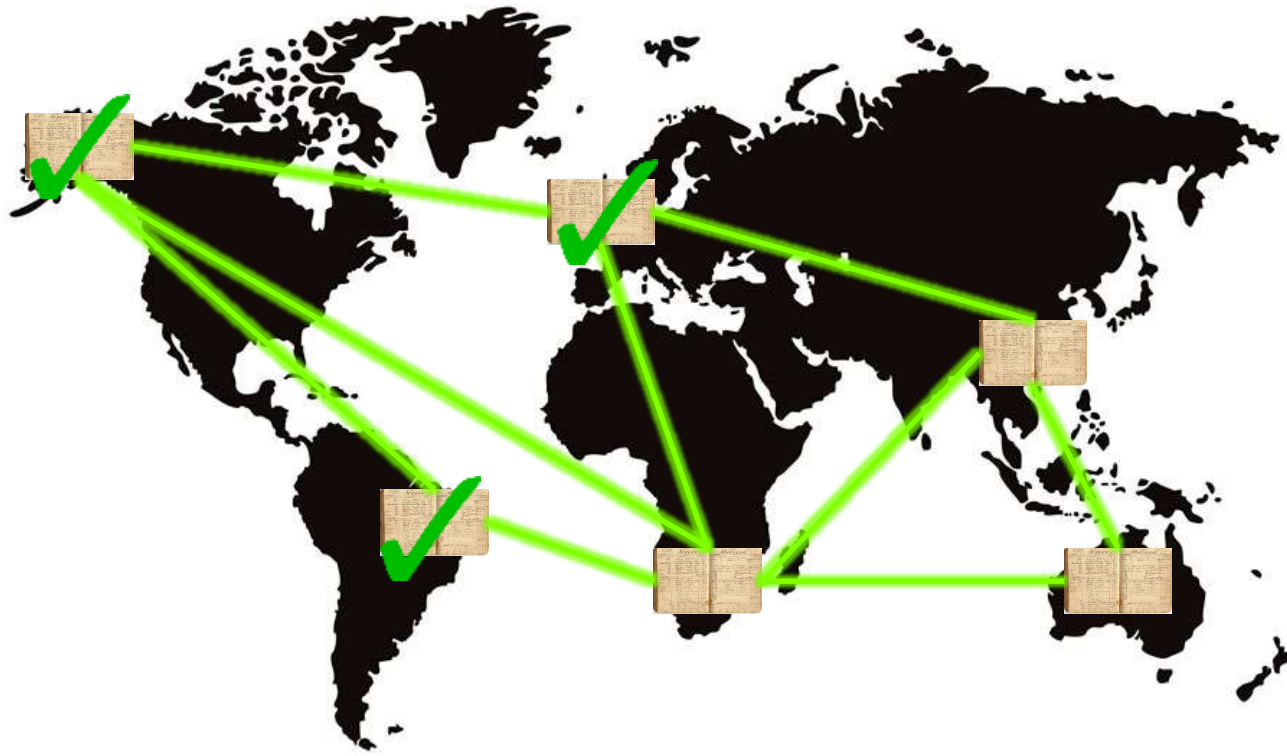
1817

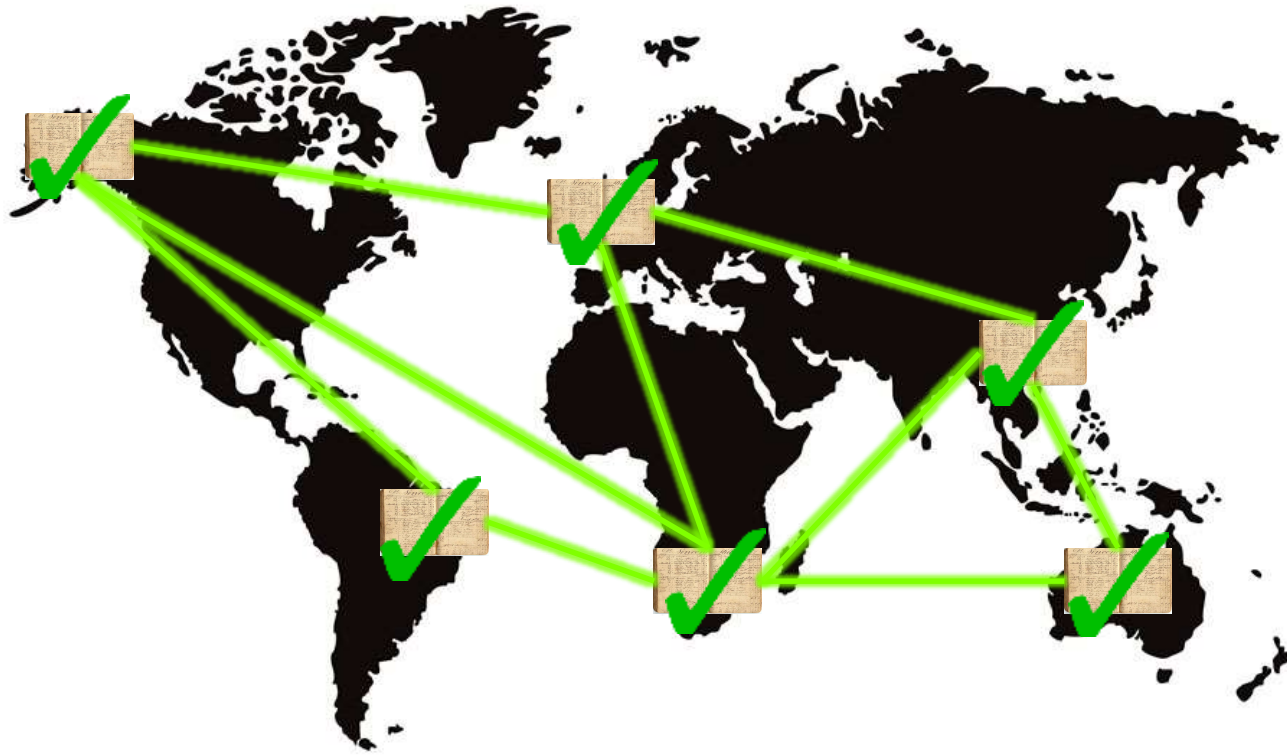
May 27	To sundries	4	9	5
March 3	" Mending 1 st Boot	1	0	"
	" Mending 2 nd Boot	2	3	"
12	" Taping 1 st Boot	5	9	"
28	" Mending 1 st Boot	5	0	"
	" Mending 2 nd Boot	2	19	"

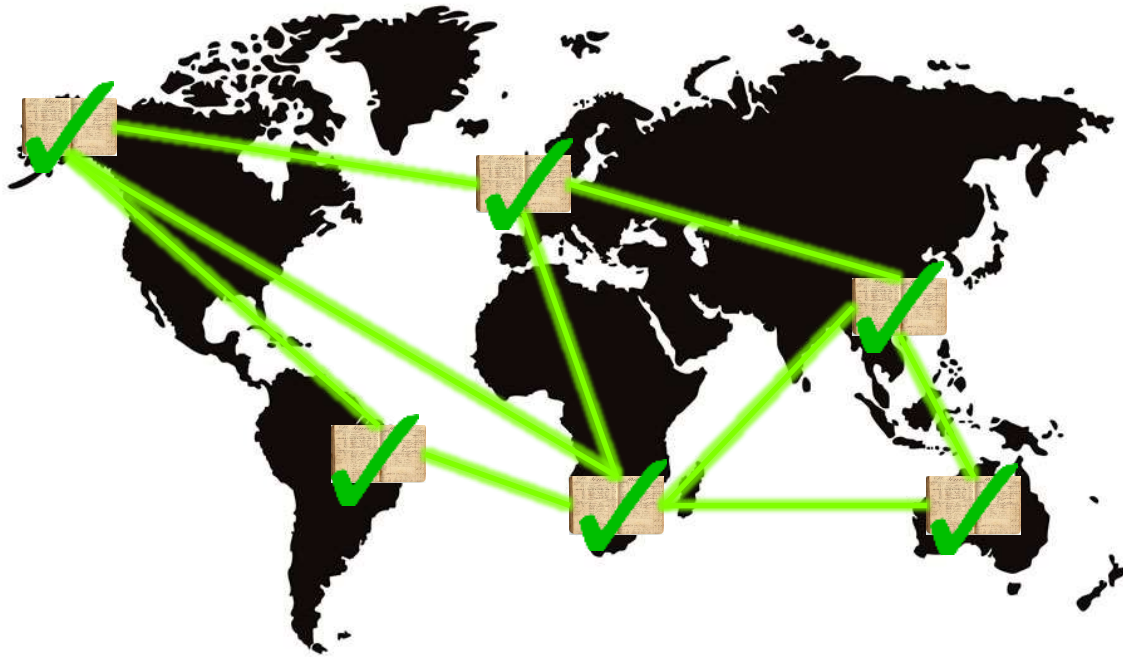








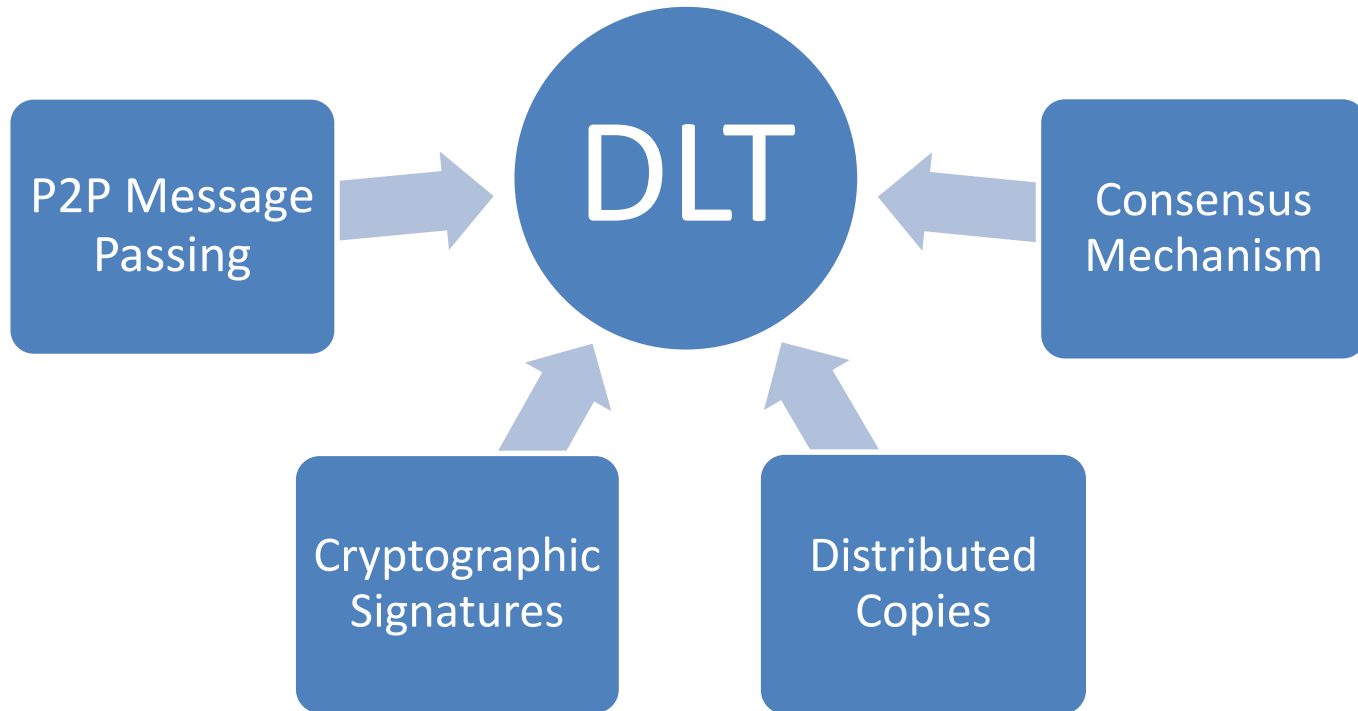




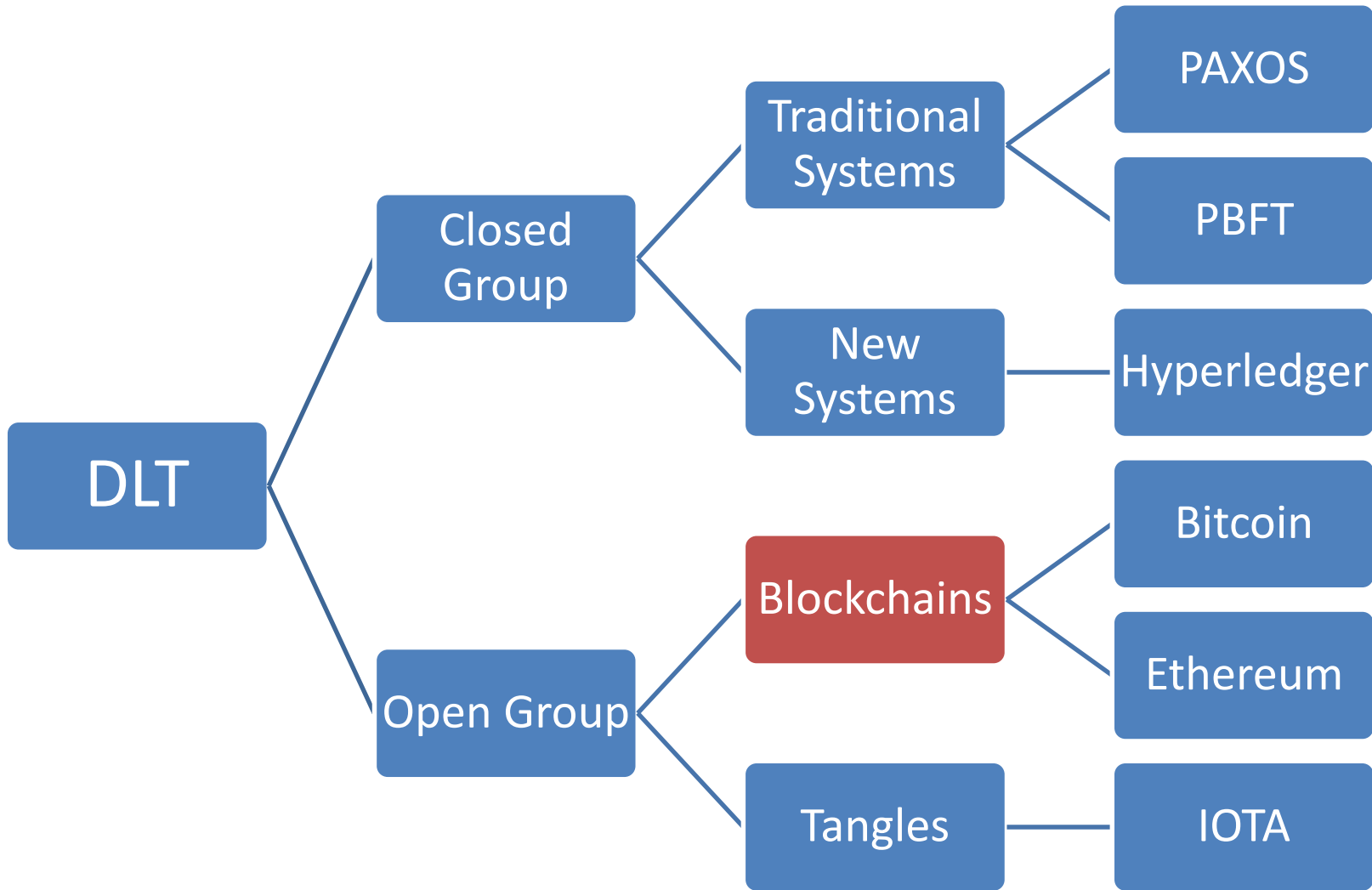
Key Features of DLT:

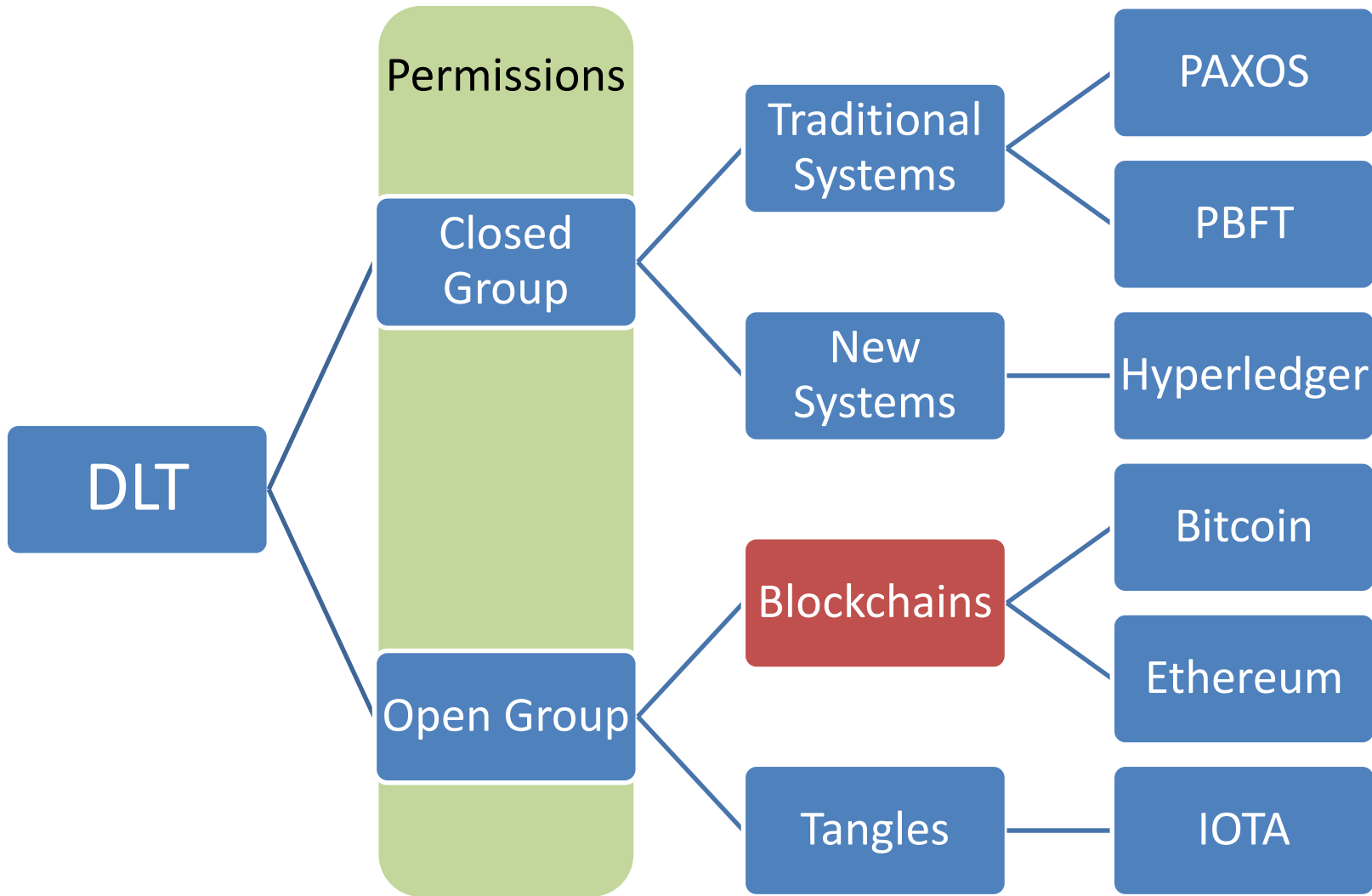
- High availability
- Synchronised records
- Secure against intrusion
 - Cryptographic keys
- Impossible to alter history

Core Components



DLT vs. Blockchain

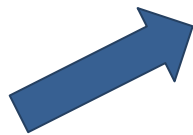
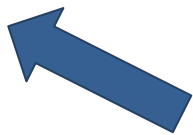


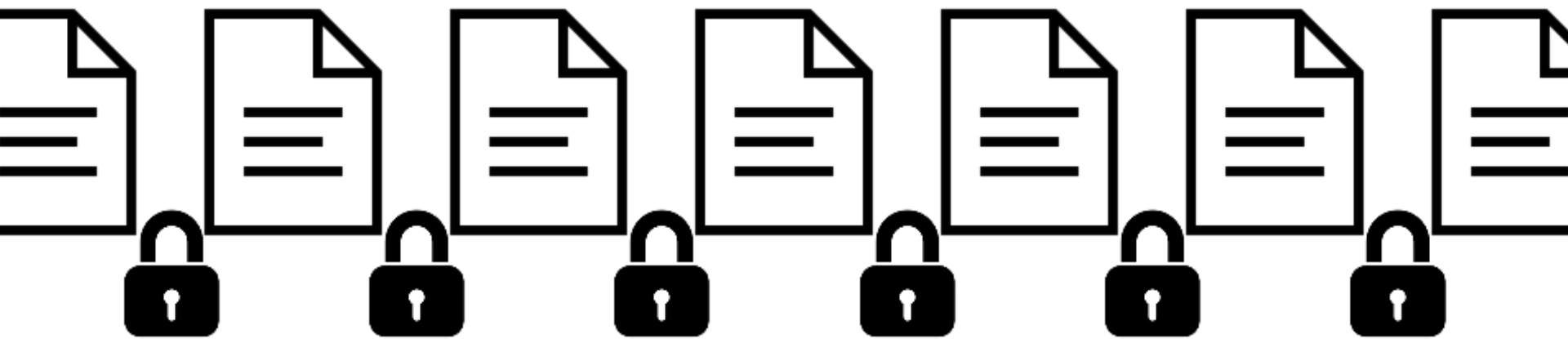


One Possible System

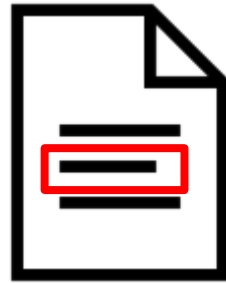
A Patient Chain





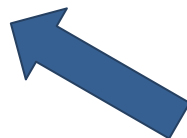
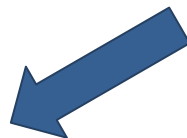
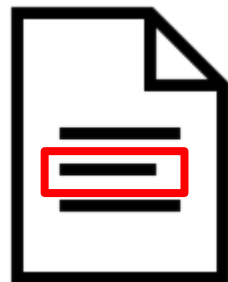








Patient



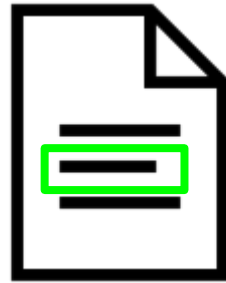
Time

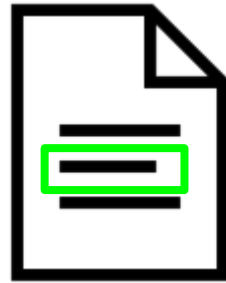


Place

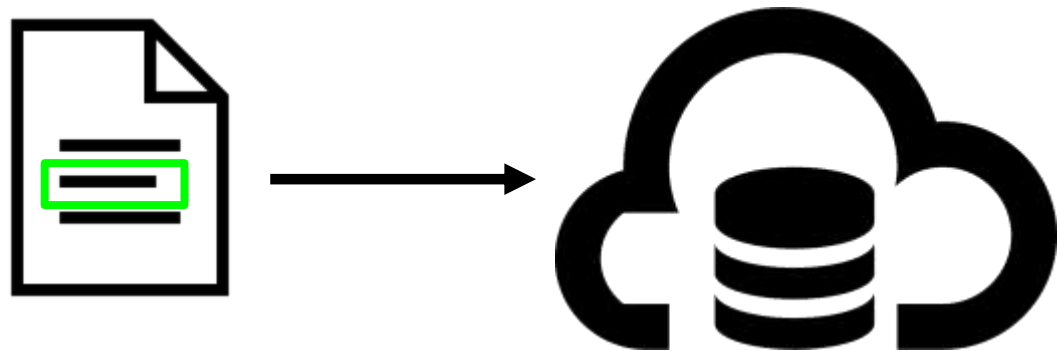


Provider

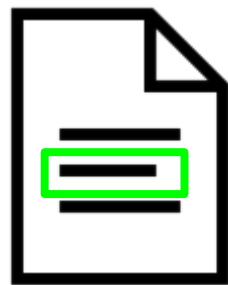




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34AG30gnq940aF53g

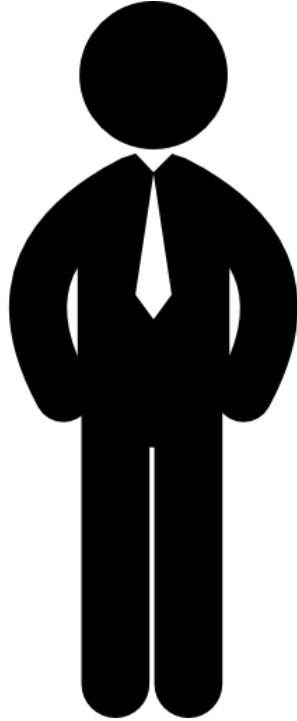


34AG30gnq940aF53g

In Conclusion

DLT in Healthcare

- Continuously available distributed records
- Access controlled by cryptographic keys
- Audit trail embedded into system
- Unable to edit history
- Standardised message passing
- **Permissionless innovation**



Thank You

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