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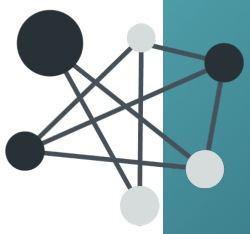
Topics Covered

- Brief primer of the challenges with COVID-19 research
- Strategies for proposing blockchain-based solutions
  - Example of digital contact tracing
- News about Research Foundry
- Q&A



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Disclaimer

- These are *my* opinions and observations, and do not necessarily represent views of my employer, Hyperledger, or the HC-SIG
- I am not an epidemiologist
- Perspectives are largely U.S.-centric
- Perspectives are from my experiences with blockchain, clinical research and evaluating technologies for health care settings

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Must Make Evidence-Based Decisions

Healthcare relies on data and high-quality research to make decisions and drive policy

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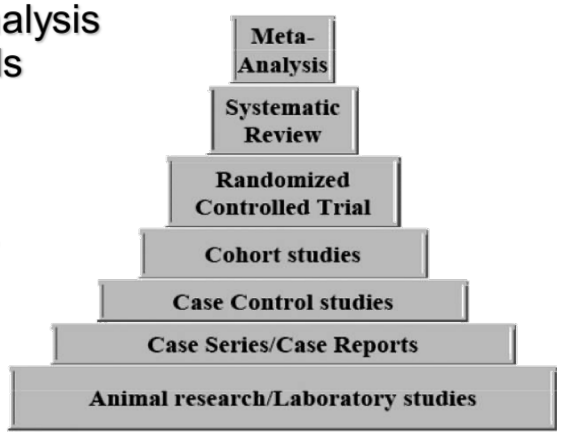
Quality of Research Evidence

Systematic Reviews /Meta-analysis
Randomized Clinical Trials

Cohort Studies
Case-Control Studies
Cross-sectional Studies

Physiologic Studies
Intuition or Beliefs



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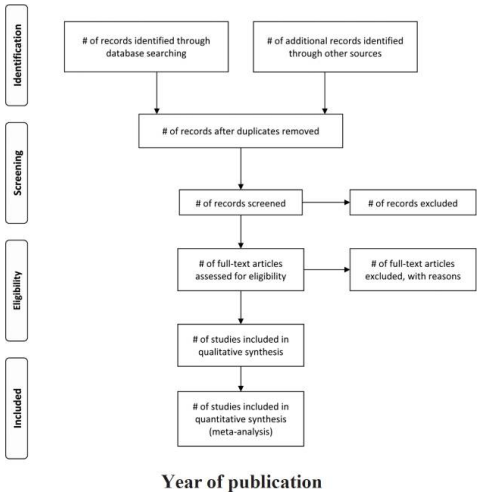
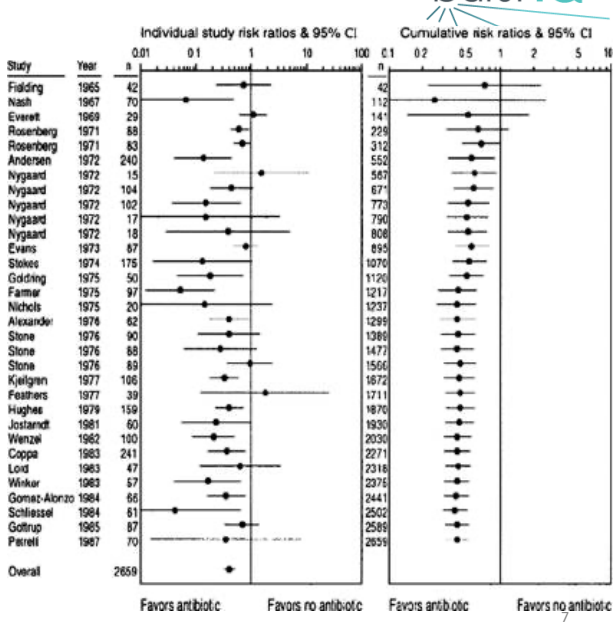
Meta-analysis





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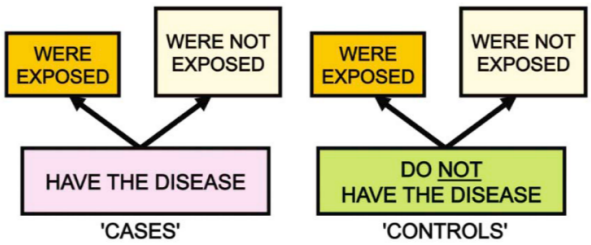
Case Control Studies



- Determine odds of developing disease based on exposure
- Why is this so hard?

	Cases	Controls
Exposed	A	B
Not exposed	C	D

$$\text{Odds Ratio} = \frac{A/C}{B/D}$$

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Still Developing COVID Tests

Tests are regulated as *in vitro* diagnostic devices

	Gold Standard (+)	Gold Standard (-)	Total
New Test (+)	A (True Positives)	B (False Positives)	A+B
New Test (-)	C (False Negatives)	D (True Negatives)	C+D
Total	A+C	B+D	A+B+C+D

Is there a "gold-standard" test to compare against?

Tests need:

- Sensitivity
- Specificity
- Validity
- Reliability

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Needed New Diagnosis Codes

World Health Organization (WHO) ICD-10:	U07.1 COVID-19, virus identified U07.2 COVID-19, virus not identified
United States ICD-10-CM:	U07.1 COVID-19
United Kingdom ICD-10 5th edition (UK):	U07.1 Emergency use of U07.1 U07.2 Emergency use of U07.2
Canada ICD-10-CA:	U07.1 Emergency use of U07.1 U07.2 Emergency use of U07.2
Australia ICD-10-AM 11th ed:	U07.1 Emergency use of U07.1 U07.2 Emergency use of U07.2 U06.0 Emergency use of U06.0

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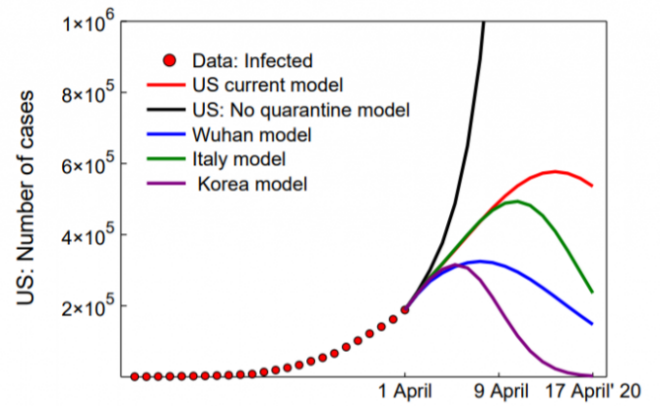
Epidemiology Models



"All models are wrong but some are useful"

-George Box

MIT News, http://news.mit.edu/2020/new-model-quantifies-impact-quarantine-measures-covid-19-spread-0416

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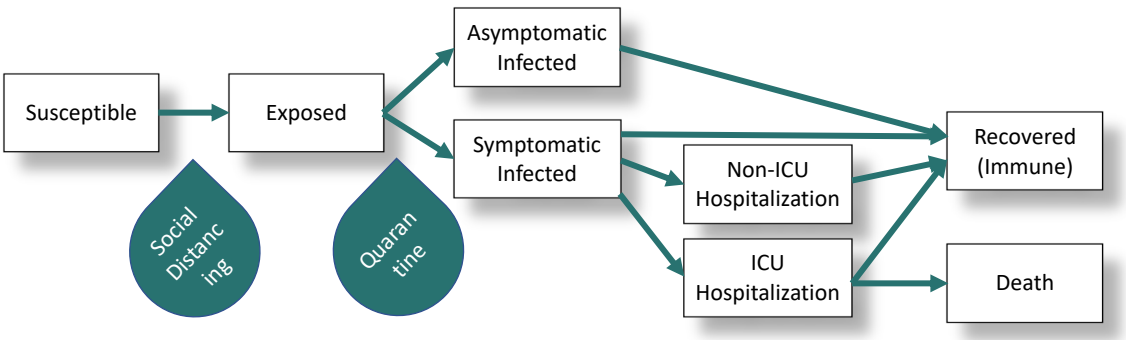
Colorado Model

Susceptible, exposed, infected, recovered model



Colorado Dept. of Public Health & Environment

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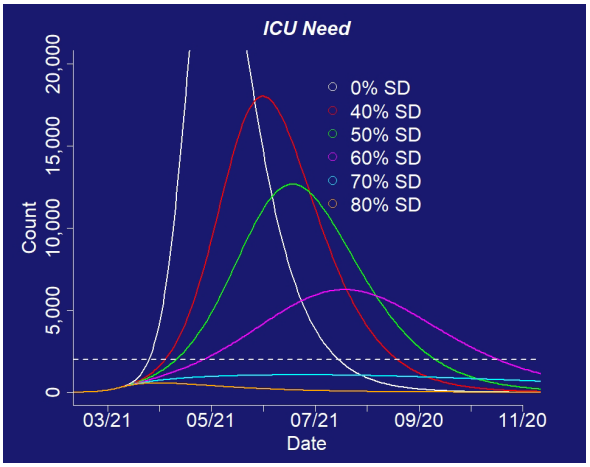
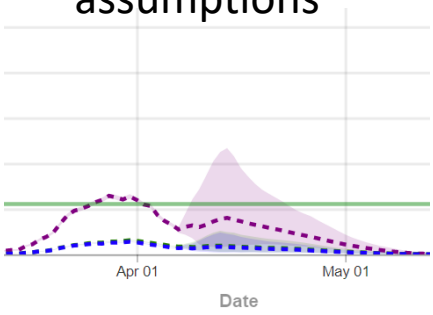
March 2020 Model Differences



Colorado Dept. of Public Health & Environment

Use different assumptions



Inst. for Health Metrics and Evaluation

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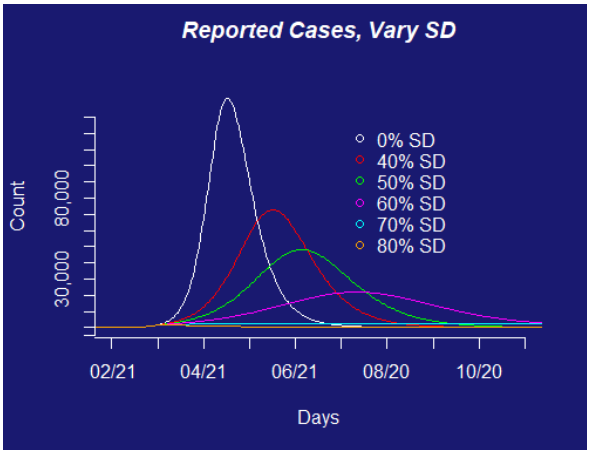
March 2020 CO Model Estimates



	Value
Proportion who self-isolate	38%
Probability of identifying symptomatic cases	28%
Effectiveness of social distancing	45%

Colorado Dept. of Public Health & Environ.

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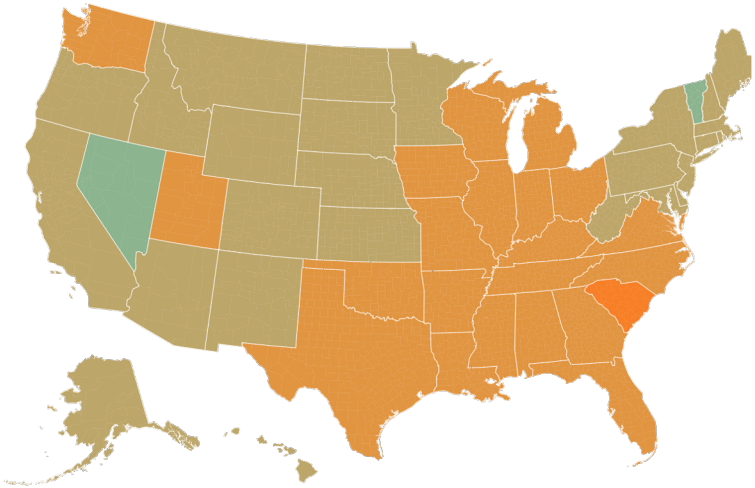
Success in Reducing Mobility

28 April 2020



https://www.unacast.com/covid19/social-distancing-scoreboard

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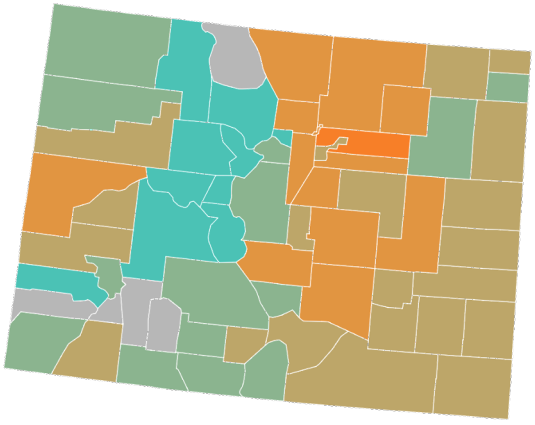
Reducing Mobility in Colorado

28 April 2020

Colorado C-

13,879 confirmed cases

40 - 55% Reduction in Average Mobility (Based on Distance Traveled)	C →
Less than 55% Reduction in Non-Essential Visits	F ↘
82 - 94% Decrease in Encounters Density Compared to National Baseline	B →



https://www.unacast.com/covid19/social-distancing-scoreboard?view=state&fips=08

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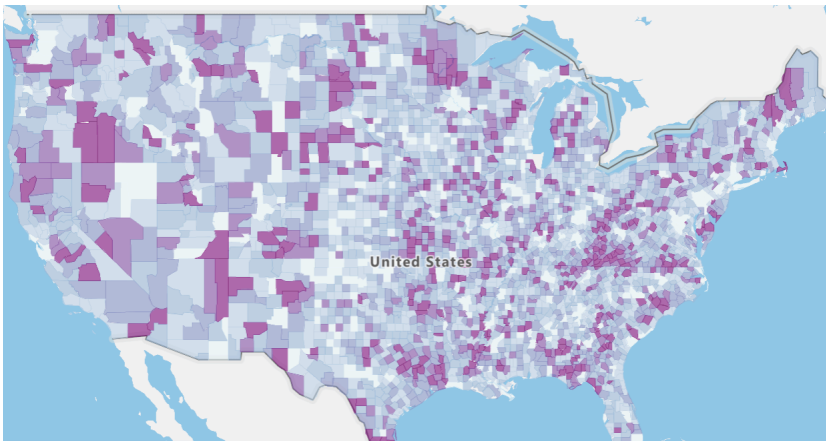
COVID Community Vulnerability



Severity of outcomes if infected with COVID

- Very Low
- Low
- Medium
- High
- Very High
- Extremely High

https://covid19.jvion.com

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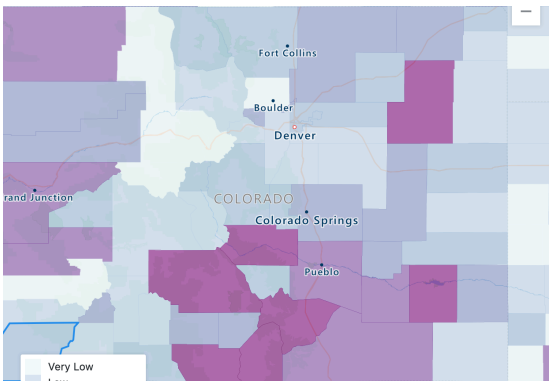
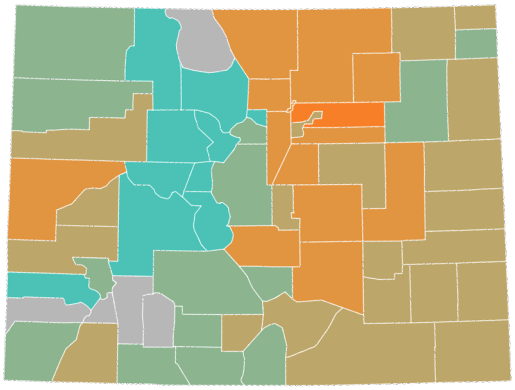
Colorado Vulnerability vs Mobility



Darker purple = higher severity



Darker orange = more mobility

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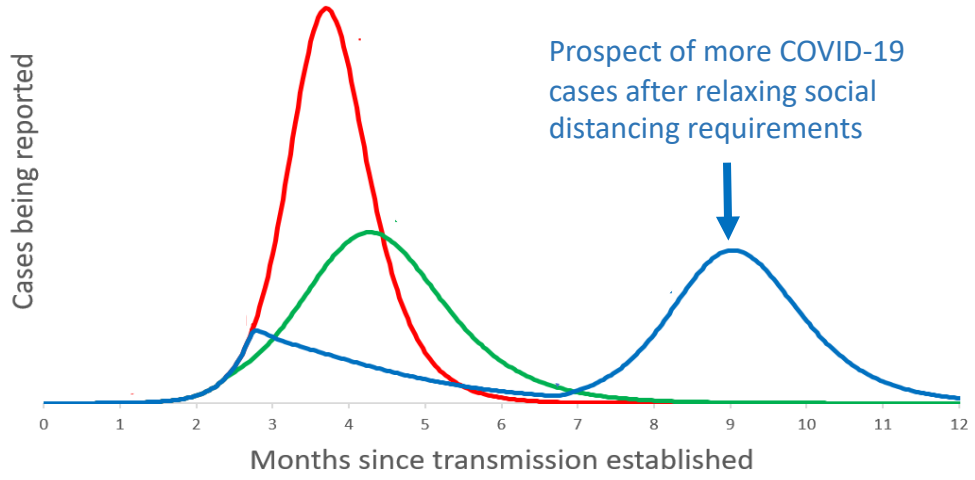
Second Peak Coming?



Lancet: https://doi.org/10.1016/S0140-6736(20)30567-5

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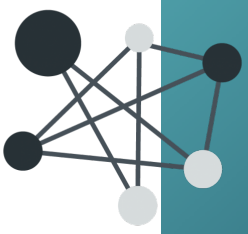
How do we Return to "Normal"?

- Wider testing
- Some degree of social distancing
- Community use of masks
- Rapid case identification → quarantine
- Symptom screening in schools and workplaces
- Development of vaccines, treatments
- Contact tracing and monitoring



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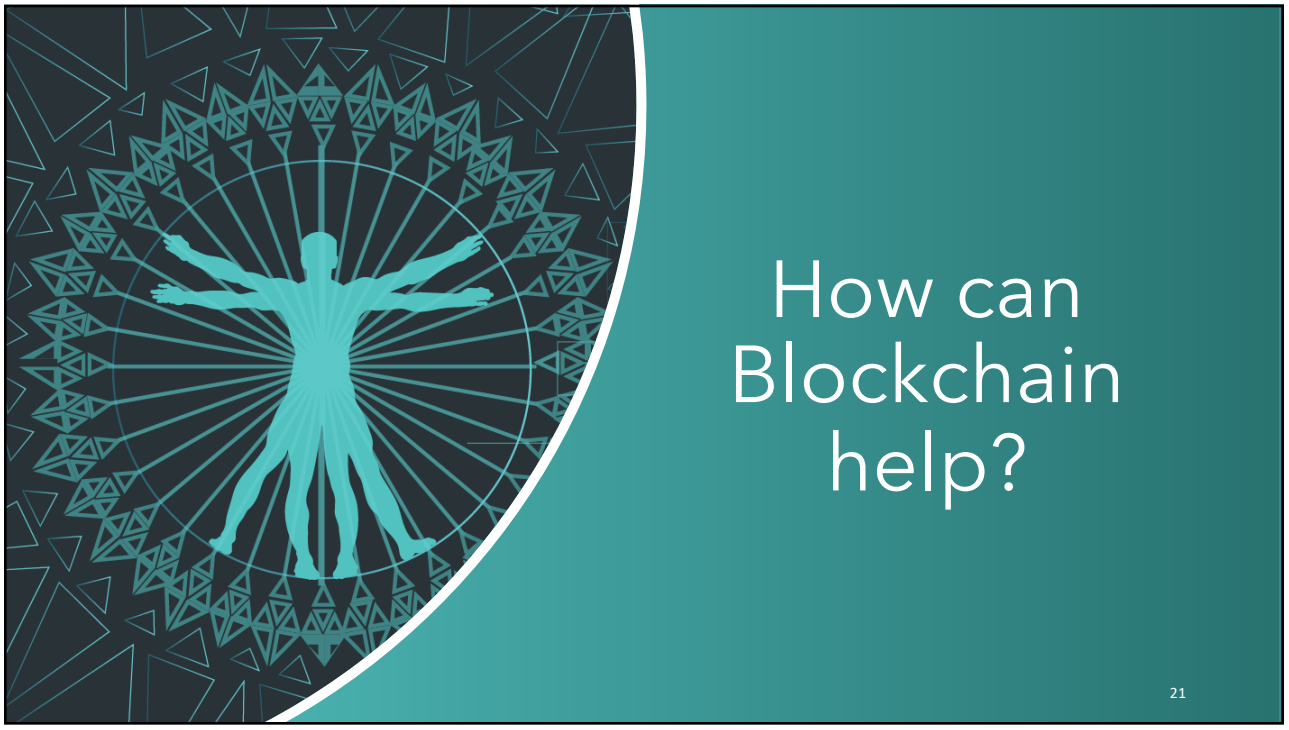

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Must first address:

burst iQ

- What is the need?
- Why blockchain? Where is the value? (short-term → long-term)
- Who are the stakeholders?
- What evidence is available?
- What requirements must be met?
- What is the right messaging?
- How would you implement the solution?

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Contact Tracing

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Digital Contact Tracing		Primary Purpose	
		Case Management *Tools to capture data on cases and contacts; some allow for automated notification and follow-up*	**Proximity Tracking** *Tools that use Bluetooth or GPS to track an individual's exposure to cases; used in addition to contact tracing case management tools*
Primary User	**PHAs**	• PHAs collect information on cases and contacts and follow up when necessary	• PHAs receive information that users choose to share to enhance contact tracing
	Cases and Contacts	• Users report symptoms and contacts and can receive information	• Users elect to share data and are alerted if they have been close to a COVID-19 case
	Key Points	• Ability to receive information from COVID-19 data systems through importation or automated means • Allow for automated notifications and follow-up	• Proximity-sensing technologies that preserve personal privacy are still under development by many groups across the country • Requires community-wide adoption

https://www.cdc.gov/coronavirus/2019-ncov/downloads/digital-contact-tracing.pdf

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Digital Contact Tracing

*** As of 28 April 2020: Fifty-three (53) contact tracing apps are available for 29 countries.** Examples:

Blockchain Solutions in Dev.

- Coalition / Nodle
- Baseline Protocol
- "Tracy" on Ethereum
- Zcash platform app
- DP3T in European Union

Non-Blockchain Solutions:

- CoronApp (Columbia)
- TraceTogether (Singapore)
- COVIDSafe (Australia)
- Aarogya Setu (India)
- Google

* https://www.top10vpn.com/research/investigations/covid-19-digital-rights-tracker/

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Google

"Exposure Notification"

Plan:

- Digital contact tracing capabilities will be built into iPhone and Android phone operating systems
- Public health agencies use APIs to build apps to use information

Guidelines:

- Data will only be used by public health authorities for COVID-19 pandemic management
- Doesn't collect personally identifiable information or user location
- List of people you've been in contact with doesn't leave phone
- Contact tracing feature will stop when pandemic is over
- Explicit user consent required

https://blog.google/documents/57/Overview_of_COVID-19_Contact_Tracing_Using_BLE.pdf

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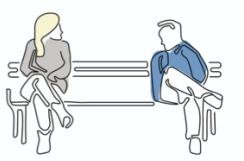
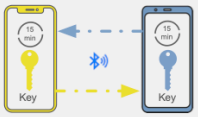
Google Steps

burst iQ

Alice and Bob meet each other for the first time and have a 10-minute conversation.



Their phones exchange anonymous identifier beacons (which change frequently).



A few days later...

Bob is positively diagnosed for COVID-19 and enters the test result in an app from a public health authority.

With Bob's consent, his phone uploads the last 14 days of keys for his broadcast beacons to the cloud.

Google

https://blog.google/documents/57/Overview_of_COVID-19_Contact_Tracing_Using_BLE.pdf

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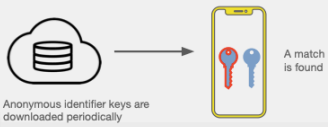
Google Steps

burst iQ

Alice continues her day unaware she had been near a potentially contagious person.

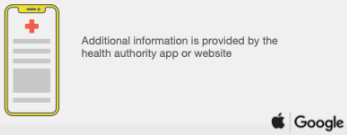
Alice's phone periodically downloads the broadcast beacon keys of everyone who has tested positive for COVID-19 in her region. A match is found with the Bob's anonymous identifier beacons.



Sometime later...

Alice sees a notification on her phone.

Alice's phone receives a notification with information about what to do next.



Google

https://blog.google/documents/57/Overview_of_COVID-19_Contact_Tracing_Using_BLE.pdf

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Data Collected with Tracing

burst iQ

INFORMATION DISCLOSED	SINGAPORE	HONG KONG	SOUTH KOREA	U.K.	GERMANY	NEW YORK
Age and gender	✓	✓	✓	✗	✓	✓
Travel history	✓	✓	✓	✓	✗	✓
Workplace address	✓	✗	✓	✗	✗	✗
Home address (area)	✓	✓	✓	✗	✗	✗
Links to previous cases	✓	✓	✗	✗	✓	✗
Nationality if case is imported	✓	✗	✓	✗	✗	✗
Treatment location	✓	✓	✓	✓	✗	✗
Places visited prior	✓	✗	✓	✗	✗	✗
Identified contact persons	✗	✓	✓	✗	✗	✗
How case was confirmed	✗	✗	✓	✗	✗	✗
Geographical breakdown of patients	✗	✓	✗	✗	✓	✓

Wall Street Journal, April 16, p A1, A9

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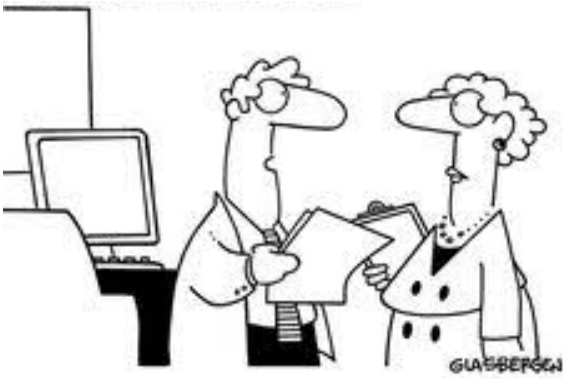
Why Blockchain for COVID-19?

burst iQ



"My team has created a very innovative solution, but we're still looking for a problem to go with it."

Blockchain must be addressing a need, not looking for a need

<u>Perform some intel</u>: TIP

What's already being done?

Why isn't that sufficient?

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Where is Value of Blockchain?

Key Dimensions	Improved Profitability and Quality				Increased Transparency		Reinvent Processes	
Capabilities	Automation		Control		Distributed		Decentralized Autonomous x	
	Full Traceability		Security		Holistic View		Enhanced Identity	
	Speed / Efficiency		Evidence Tampering				Tokenization & Digital Assets	
Value Drivers	Audit-ability	Compli-ance	Data Mgmt	Data Security	Data Sharing	Resiliency	Authen-tication	Identity Mgmt
	Owner-ship	Payments	Process Auto-mation	Recon-ciliation	Trans-parency	Trust	Market-place creation	New products
		Standard-ization	Track and Trace				New / expanded partnerships	

World Economic Forum (2019)

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Why Blockchain?

- Integrates multiple siloes of data
- Manage credentials, immunity passports
- Offers zero-knowledge proofs
- Granular consent / fine-tuned consent to manage access
- Smart contracts for triggers / incentives
- Secure, tamper-evident / tamper-resistant

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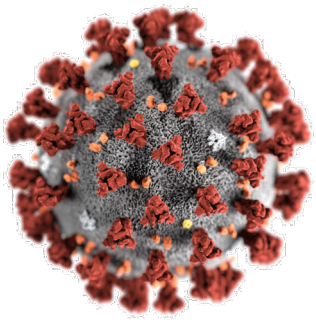
Short- and Long-Term Plan?

Short-term
Must be *actionable* now



Long-term
Must be *sustainable*

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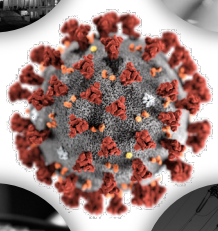
Who are the Stakeholders?

REGULATORS
Regulatory agencies, IRBs, compliance staff

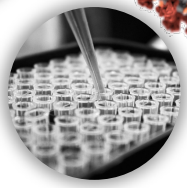
EMERGING INNOVATORS
Digital health providers

ENTERPRISES
Health systems, life science companies etc.



PATIENTS
Through patient-facing services and opportunities

RESEARCHERS
Commercial & academic



PLATFORM PROVIDERS
Blockchains, mobile carriers, ISPs, payment platforms

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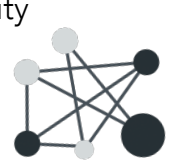
Knowledge Required (CDC)

Contact tracing is a **specialized skill**. To be done effectively, it requires people with the **training**, **supervision**, and **access to social and medical support for patients and contacts**. Requisite knowledge and skills …

- **Understanding of the medical terms and principles** of exposure, infection, infectious period, potentially infectious interactions, symptoms of disease, pre-symptomatic and asymptomatic infection
- **An understanding of patient confidentiality**, including the ability to conduct interviews without violating confidentiality (e.g., to those who might overhear their conversations)

https://www.cdc.gov/coronavirus/2019-ncov/php/principles-contact-tracing.html



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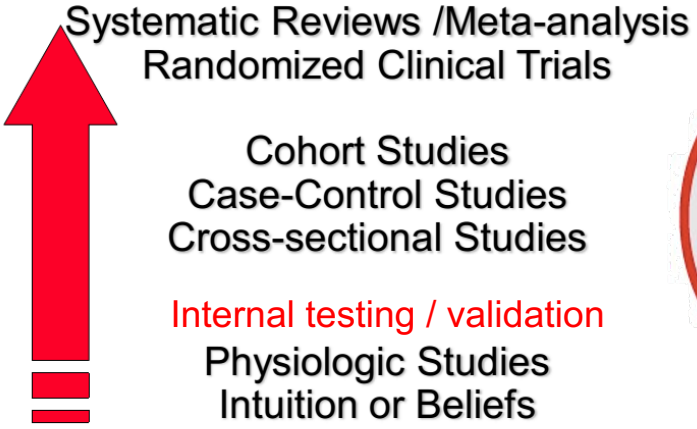
What Evidence is Available?



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Is there Regulatory Oversight?

burst IQ

CMS CENTERS for MEDICARE & MEDICAID SERVICES

DEPARTMENT OF VETERANS AFFAIRS

NATIONAL INSTITUTES OF HEALTH

GDPR

AHRQ Agency for Healthcare Research and Quality Advancing Excellence in Health Care • www.ahrq.gov

FDA U.S. FOOD & DRUG ADMINISTRATION

DEPARTMENT OF HEALTH & HUMAN SERVICES • USA

The Office of the National Coordinator for Health Information Technology

CDC

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Key:

Case mgmt.

Proximity tracking

Preliminary Criteria for the Evaluation of Digital Contact Tracing Tools for COVID-19

COVID-19 Contact Tracing for Health Departments

Introduction

The following preliminary[1] criteria define minimum and preferred characteristics of digital contact tracing tools to help health departments overcome one or more obstacles in the COVID-19 contact tracing workflow[2]. They are based on preliminary research and targeted discussions with contact tracing and informatics experts across county, state, and federal government; national public health associations; academic consortia; and nongovernmental organizations.

Listed in Table 1 below are minimum and preferred criteria applied to two distinct categories of contact tracing technology: those for case management[3], and those for proximity tracking[4]. Minimum and preferred criteria of the tools' technical and general attributes are described in Table 2.

= case management = proximity tracking

Table 1. Minimum and Preferred Capabilities of Digital Contact Tracing Tools

Contact Tracing Task	Criteria	
	Minimum	Preferred
Case Identification	• Enables PHAs[5] to import existing data (e.g., from PHA information systems)	• Can be configured for real-time synchronization of data from PHA information systems • Enables laboratory-confirmed index patients to self-report relevant demographic data and the best means of communication
Contact Elicitation / Identification	• Enables PHAs to manually record data on contacts of index patients	• Enables index patients to self-report contacts • Can seamlessly import proximity data from index patient when consent received
Contact Notification	• Enables manual and automated notifications[6] to known contacts in the following order of priority: recorded voice message, email, and SMS • Messaging can be tailored to the likelihood of exposure, include links to health information resources, and provide next steps (e.g., testing, self-isolation)	• Enables anonymous[7] automated notification to community contacts based on history of proximity to index patient (i.e., within 6 feet for 30 minutes or more)
Contact Follow-up	• Enables PHA to initiate direct, manual follow-up with known contacts and collect longitudinal data • Enables seamless restart of logic model / workflow upon confirmation of case status among any known contact	• Enables automated dispatch of reminders to known contacts and community contacts for 14 days with directions to call PHA or electronically self-report symptoms • Self-reported data are used for automated prediction of case classification and provide immediate notification to PUI and PHA when infection is likely

CDC

cdc.gov/coronavirus

Table 2. Minimum and Preferred Attributes of Digital Contact Tracing Tools

Attribute	Minimum	Preferred
Technical		
Platform Support	• Can be easily used within web browser on mobile environment • Can be easily used within web browser on desktop environment • Supports offline data entry and caching	• Provides cross-platform functionality (Android, and iOS, with reasonable backwards compatibility for older Android and iOS versions) • Supports offline data entry and caching across platforms
Data Interoperability	• Supports manual data import from PHA information systems • Supports manual data export in common formats	• Supports OAuth-secured programmatic means of data transfer[8] between information systems within and between jurisdictions
Trustworthiness	• Uses open architectures and open standards	• Is open source
Users	• User access for PHAs	• User access by index patients and their contacts
Availability	• Ready to use and rapidly deployable	• Already being used successfully by jurisdictions
Customizability	• Requires vendor to perform all customizations for PHAs	• Allows PHAs to perform some of their own customizations (e.g., adding new data elements, implementing data validation rules)
Privacy	• All use of personally-identifying information (PII) data is predicated on consent of index patient / contact, and all other data are anonymized before sharing • Data are encrypted in transit and at rest • Authorized data access only for PHAs and must be limited to need-to-know basis	• Provides individuals access to their own data, and ability to delete / revoke consent at any time
General		
Technical Support	• Developer / vendor provides comprehensive technical support for PHAs	
Vendor Experience	• The developer / vendor has experience working in public health settings	
Localization	• Self-reporting features are available in index patient's and contact's language of choice	

1. This document should be viewed as a living body of knowledge. It will be updated as more is learned.
2. This includes index case identification, contact elicitation / identification, contact notification, and follow-up.
3. Tools to streamline the electronic capture and management of data on cases and contacts; may also provide means of automating communication and follow-up with contacts of an infected individual.
4. Tools that use Bluetooth or GPS technologies to estimate the proximity and duration of an individual's exposure to an infected person; used in addition to contact tracing case management tools.
5. Public health authorities, including local, state, tribal, and territorial public health departments.
6. We recommend that automated messaging incorporate support-building human elements (e.g., delivered in audio or video by trusted local or national health figure).
7. For tools using geolocation-based proximity tracking, we recommend anonymous selective broadcasting method, for tools with Bluetooth-enabled proximity tracking, we recommend decentralized, bidirectionally anonymous methods. For an example of a protocol that employs this method, see the PACT protocol. Inclusion does not indicate endorsement.
8. E.g., RESTful API conforming to a common standard for data sharing between tools.

https://www.cdc.gov/coronavirus/2019-ncov/downloads/php/prelim-eval-criteria-digital-contact-tracing.pdf

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Approvals Needed?

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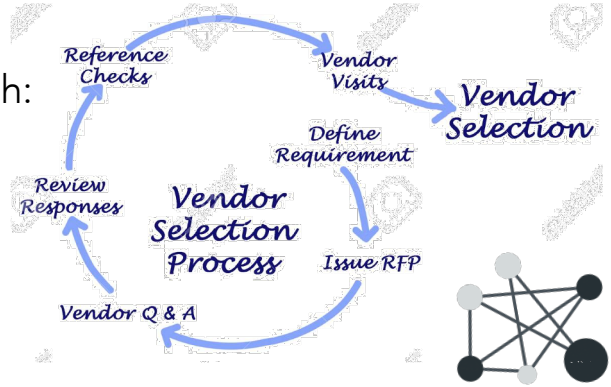
Government / Organization review and approval

- Explain what blockchain is
- How product is consistent with:
  - Expected CDC / ONC criteria?
  - Published best practices?
- Need association with public health agencies?
- Need to connect to PHA / health information systems?



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Implementation Plan

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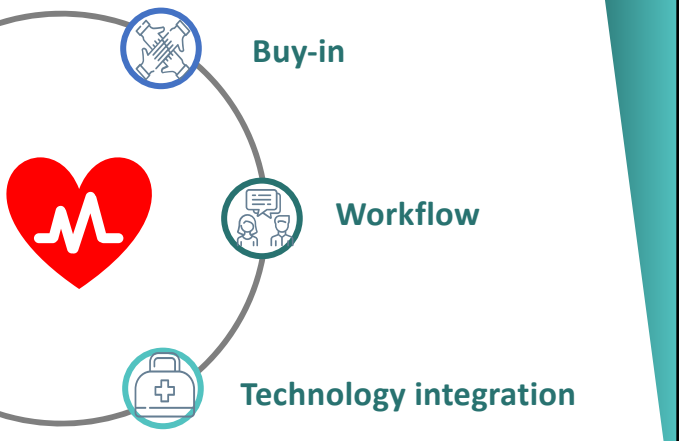

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Implementation Buy-in

Would enough citizens:

- Trust in how data will be used?
- Get tested?
- Opt-in to digital contact tracing?
- Opt-in for a single digital contact tracing solution?

Research findings

Oxford study:

- 80% of smartphone users (56% of entire UK population) must opt-in to be effective

Singapore downloads:

- 12-20% of population downloaded app

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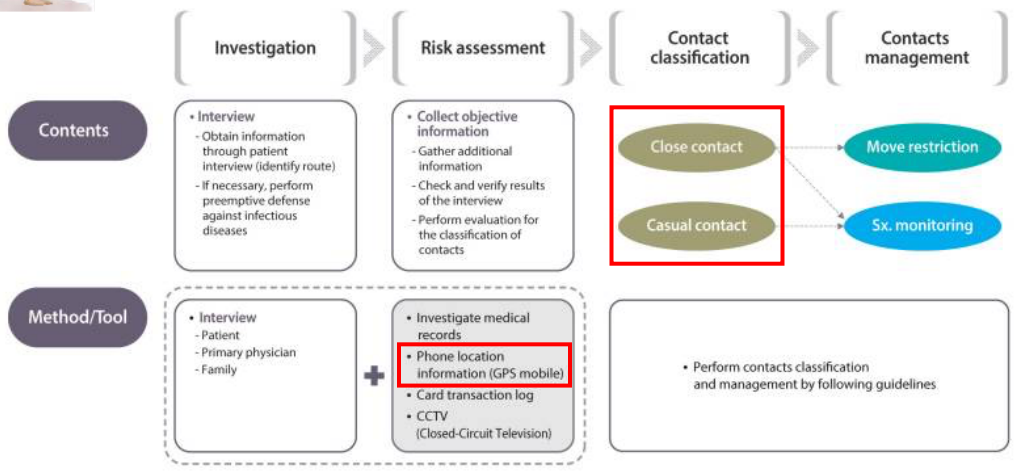
Implementation Workflow



Workflow implemented in South Korea: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7045882/

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Implementation Integration

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Forbes

Apple And Google Contact-Tracing Surprise: 2.5 Billion Users Will Miss Out

Zak Doffman Contributor ⓘ
Cybersecurity
I write about security and surveillance.

https://www.forbes.com/sites/zakdoffman/2020/04/20/apple-and-google-major-contact-tracing-surprise-25-billion-users-lose-out/#6b83f4c4190a

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Implementation Integration

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How will you ensure that enough people have:

- Cell phones?
- Smart phones?
- Bluetooth capabilities?
- Sufficient battery capacity?
- Ability to transmit digital information freely (Not certain in countries)

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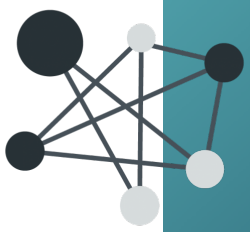
Privacy Concerns

- "De-identified" data might be re-identified
- Only 25% of apps provide privacy policies
- Data collection is not sufficiently reliable
- Many apps have insufficient security methods
- Lack of transparency about data uses
- Unauthorized surveillance & abuse



https://www.nytimes.com/2020/04/29/business/coronavirus-cellphone-apps-contact-tracing.html,
https://www.top10vpn.com/research/investigations/covid-19-digital-rights-tracker/

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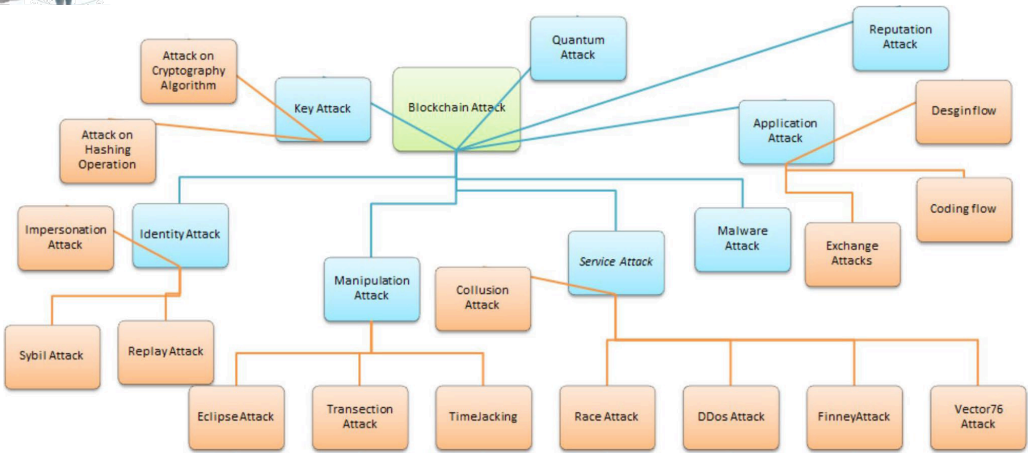
Additional Blockchain Risks



Dasgupta D, Shrein JM, Gupta KD. A survey of blockchain from security perspective. J Bank Financ Technol. 2019;3:1-17. doi: 10.1007/s42786-018-00002-6.

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Sustainability

- Government intervention
- Policies
- Funding
- How do you maintain:
  - Usage
  - Updates
  - Training
  - Support

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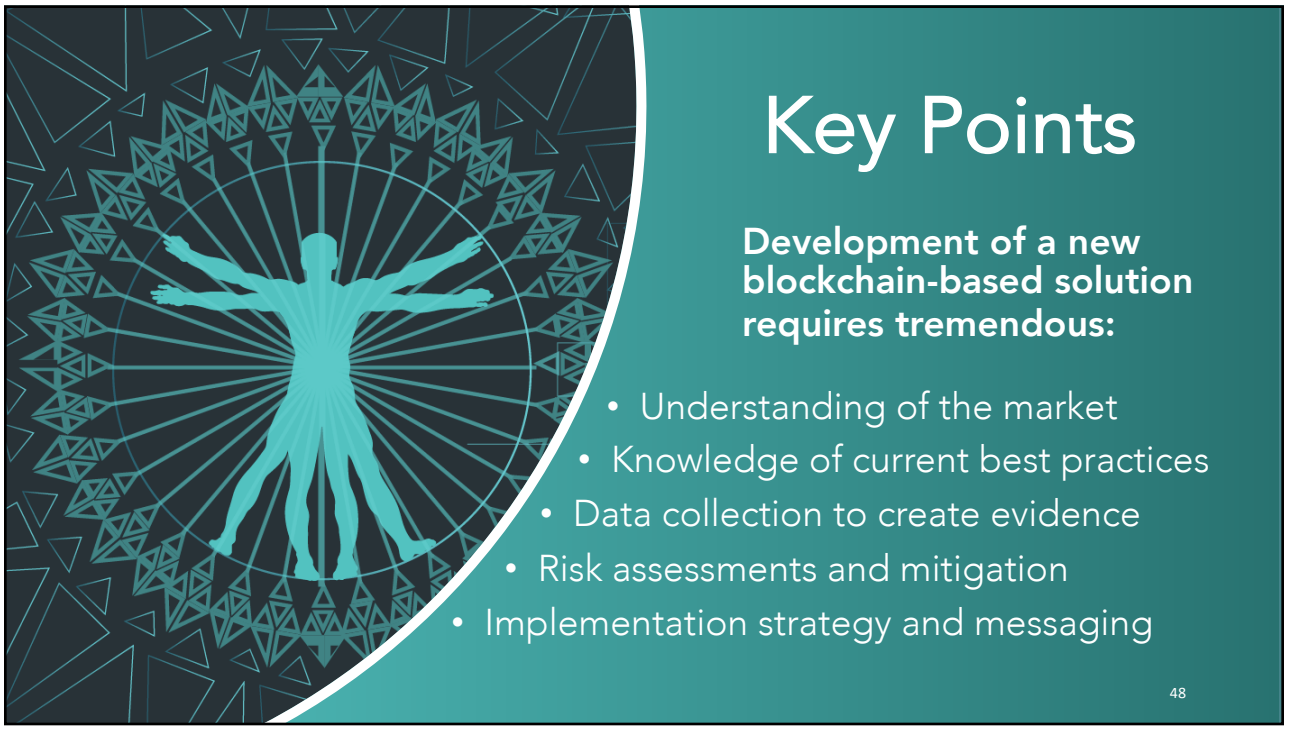

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Need for Collaborative Solutions

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RESEARCH FOUNDRY

A Global Research & Innovation Network

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Crush COVID-19 and beyond

Humanitarian (non-revenue-generating) blockchain environment to:

- Advance research about this pandemic
- Prepare for future public health needs
- Promote collaborations

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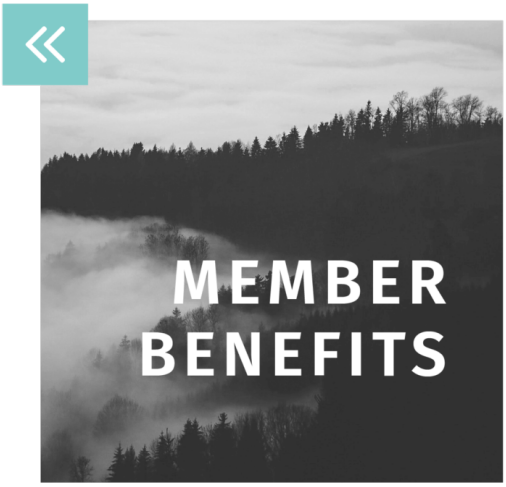
Blockchain Utility Service



- No cost for participation
- Access for anyone, anywhere
- Creativity without risk
- Security and auditability
- Interdisciplinary research connections

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Ways to Participate

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Propose a project

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Ways to Participate

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Develop an application (and layer blockchains)

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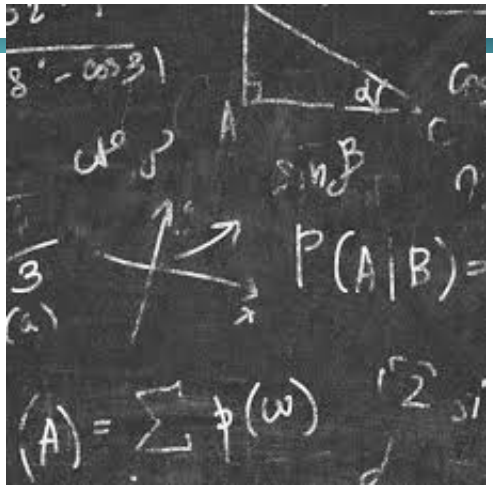
Ways to Participate

Access and analyze data sets



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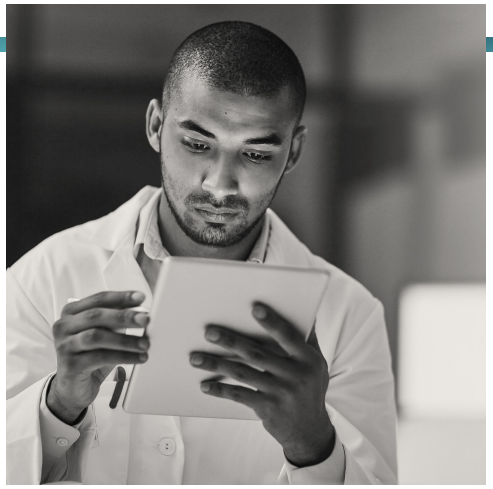
Ways to Participate

Contribute your knowledge and expertise



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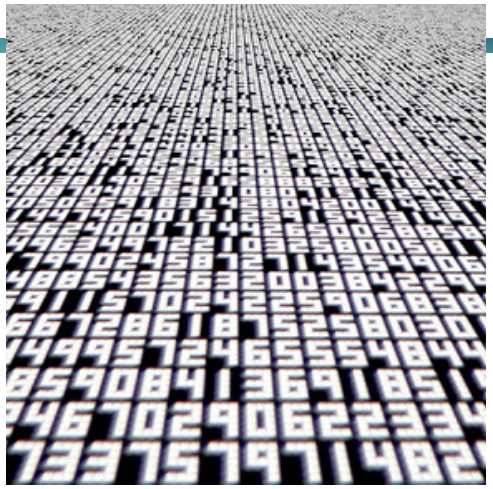
Ways to Participate

Contribute data



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Platform Privacy / Security

HIPAA
Health Insurance Portability and Accountability Act

GDPR

SOC 2 TYPE II CERTIFIED

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Other Features

- Many corporate and association partners
- Collaborative environment
- Crowdsourcing options
- HeroX challenges
- Perform analyses on chain
- Governance Committee oversight

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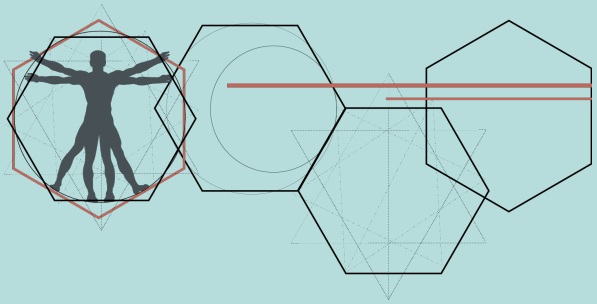
SIGN UP

www.ResearchFoundry.com



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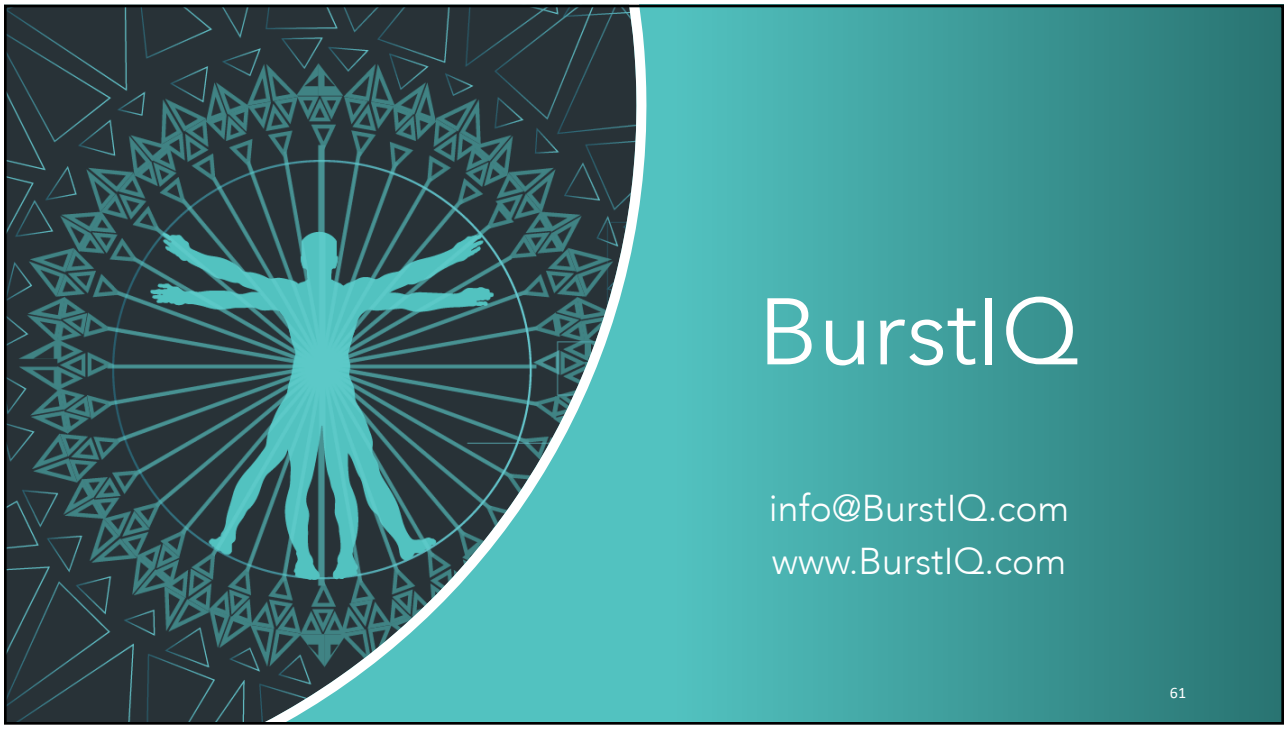

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