

TIPPSS to Protect Virtual Humans from Real Risks

Virtual Human Global Summit II
Accelerating Adoption of Virtual Human Twins in Healthcare
SUNY Global Center, NYC and Barcelona, Spain
October 23, 2024

Florence Hudson, Executive Director, Northeast Big Data Innovation Hub, Data Science Institute, Columbia University;
PI, NSF Northeast Big Data Innovation Hub, COVID Information Commons, Prototype Open Knowledge Network;
Vice Chair, IEEE Engineering Medicine and Biology Society;
Chair, IEEE/UL Clinical IoT data and device interoperability with TIPPSS (Trust, Identity, Privacy, Protection, Safety, Security);
Founder and CEO, FDHInt, LLC



Funded by NSF
#1550284, 1748395,
1916585, 2028999,
2139391, 2333532;
National Institutes of
Health (NIH);
US Department of
Transportation
Federal Highway
Administration;
Defense Advanced
Research Projects
Agency (DARPA)

Northeast Big Data Innovation Hub

- The NEBDHub is a Community convener, collaboration hub, and catalyst for data science awareness, education and innovation.
- The Hub Community includes 24,044 individuals at 2,133 academic, industry, nonprofit & government institutions.
- The Hub's following four focus areas guide our work:



Education & Data Literacy

National Student Data Corps (NSDC)



Health

COVID Information Commons (CIC)



Urban to Rural Communities

Transportation Data Science Project (TDSP)



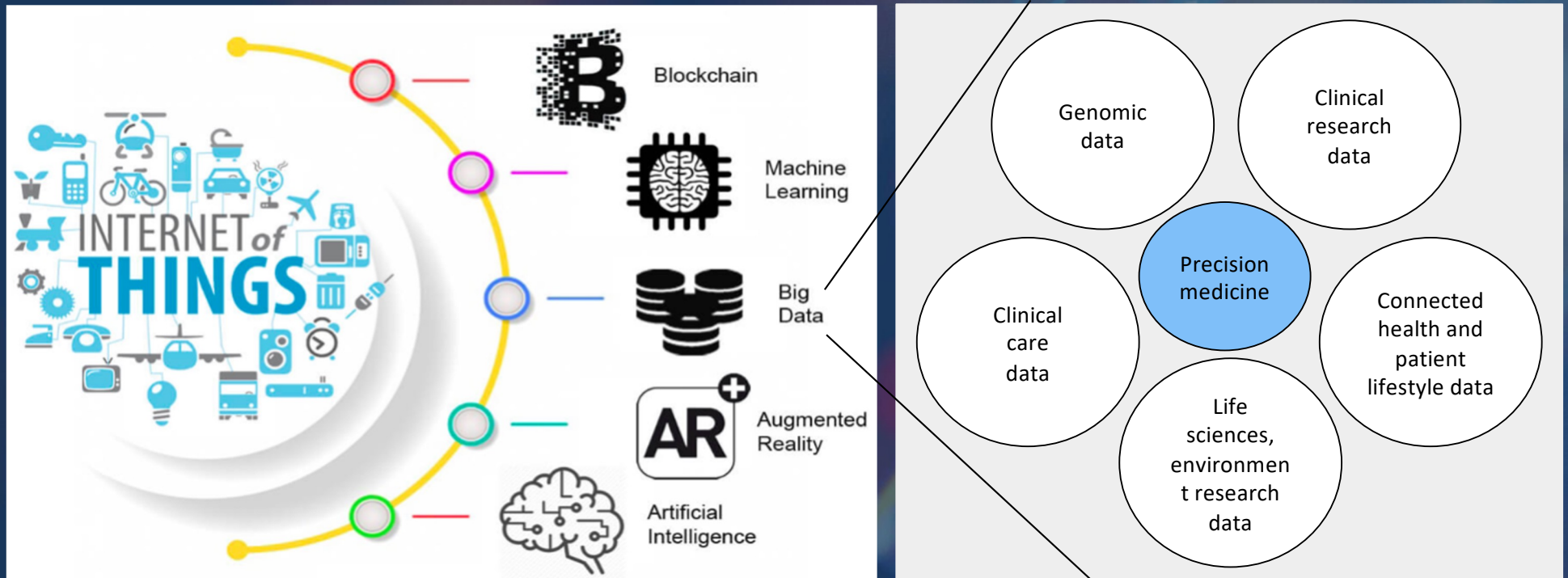
Responsible Data Science

Security, Privacy & Ethics

TIPPSS Initiative - Trust, Identity, Privacy, Protection, Safety, Security

<http://nebigdatahub.org/about/>

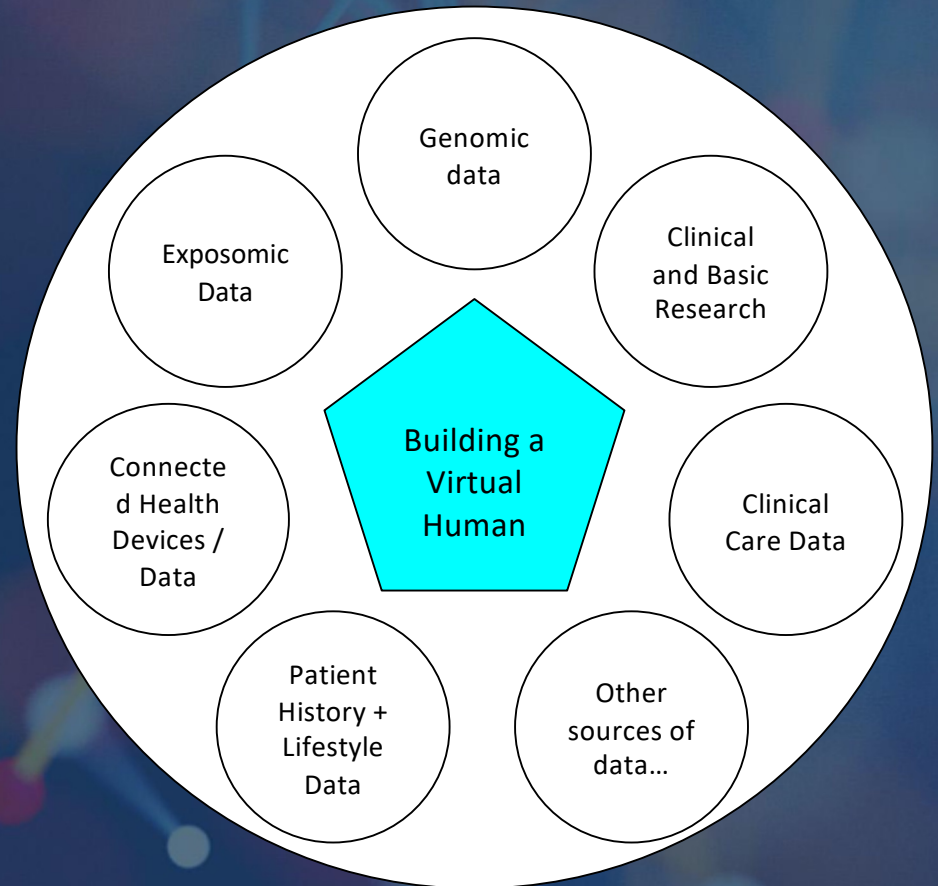
Advanced technologies can harness and analyze vast amounts of data to enable precision medicine and improve outcomes... and add risk



Reference: Handbook of Statistics, Volume 35, Cognitive Computing: Theory and Applications, Elsevier 2016, Editors: VV Raghavan, VN Gudivada, V Govindaraju, CR Rao; Chapter 11, The Internet of Things and Cognitive Computing, Authors FD Hudson and EW Nichols, ISBN 9780444637444

As we develop Virtual Humans, the risk will continue to grow

- More data
- More physical and virtual access points and attack vectors
- More devices, mobile devices “in the wild,” less secure environments
- More accessibility - by providers, patients, payers, researchers, vendors, governments, malicious actors, etc.
- Malicious motivations include financial, political, personal, institutional



More devices, data and access create more security and privacy attack vectors and risk

“Any medical device connected to a communications network, like Wi-Fi, or public or home Internet, may have cybersecurity vulnerabilities that could be exploited by unauthorized users.”

*Dr. Suzanne Schwartz
Director, Office of Strategic Partnerships &
Technology Innovation,
Center for Devices & Radiological Health, US FDA
July 2019*



Source: <https://www.drugwatch.com/news/2019/07/11/medical-device-cyber-attacks-tv-plot-or-dangerous-reality/>

Protect the data, devices and humans from harm - the Virtual Human Twins and, by extension, the real humans.

The challenge:

Reducing the risks to humans, data, devices, and organizations due to growing cybersecurity challenges in connected systems, with a focus on the valuable virtual human twin assets.

Virtual human twins provide value, both for healthcare and hackers.

The questions:

- What if the virtual human is hacked?
- What if the data informing the virtual human is hacked, changed, compromised?
- What if the research informing the virtual human design, development, algorithms, or recommendations are compromised?
- How to secure the virtual human twin and all the inputs and outputs?
- How to detect breaches, malicious or accidental, from humans, devices, systems, services?
- How to enable trust and confidence in the virtual human twin and the underlying data?

We must secure healthcare devices & data while enabling interoperability to help protect the humans

Top concerns:

- Connected healthcare devices and data
- Connected hospitals, campuses, cities, vehicles
- Clinical, scientific and research device and data integrity

Protection needed regarding:

- Device, hardware, software, service hacks
- Physical health and safety risk
- Financial risk, reputational harm
- Data theft, data integrity, loss of privacy
- Defense in depth – Hardware, firmware, software, service

Need to evolve policy and culture.

“They’re going to try to hack everything,” warns Florence Hudson of IBM. “I am most worried about security in healthcare, in cars and moving vehicles and in critical infrastructure.”

KPMG

Security
and the IoT
ecosystem

“Security really needs to be designed into IoT solutions right at the start. You need to think about it at the hardware level, the firmware level, the software level and the service level. And you need to continuously monitor it and stay ahead of the threat.”
- Florence Hudson, IBM Vice President, 2015

Source: <https://assets.kpmg/content/dam/kpmg/pdf/2015/12/security-and-the-iot-ecosystem.pdf>

Leverage the IEEE 2933™-2024 Standard for Clinical IoT Data & Device Interoperability with TIPPSS



This standard establishes the framework with TIPPSS principles (Trust, Identity, Privacy, Protection, Safety, Security) for Clinical Internet of Things (IoT) data and device Interoperability. This includes wearable clinical IoT and interoperability with healthcare systems such as Electronic Health Records (EHR), Electronic Medical Records (EMR), other clinical IoT devices, in-hospital devices, *and future devices and connected healthcare systems. All large and small connected devices are in the scope of IoT.*

- Working Group Launched 2019
- 300+ WG members from 33 countries, 6 continents
- Standard approved by IEEE and UL in June 2024
- Standard published by IEEE and UL in September 2024
- Awarded the 2024 IEEE Emerging Technology Award
- Developing TIPPSS Maturity Model
- *New IEEE TIPPSS Roadmap Task Group - join the team!*



<https://nebigdatahub.org/tippss/>

TIPPSS is the new Cybersecurity Paradigm - Trust, Identity, Privacy, Protection, Safety, Security

- **Trust:** Allow only designated people/services to have device or data access
- **Identity:** Validate the identity of people, services, and “things”
- **Privacy:** Ensure device, personal, and sensitive data is kept private
- **Protection:** Protect devices and users from harm – physical, digital, financial, reputation
- **Safety:** Provide safety for devices, infrastructure and people
- **Security:** Maintain security of data, devices, people, etc.



Planning to Extend the TIPPSS Standard further into Healthcare and Many Cyber-physical Systems



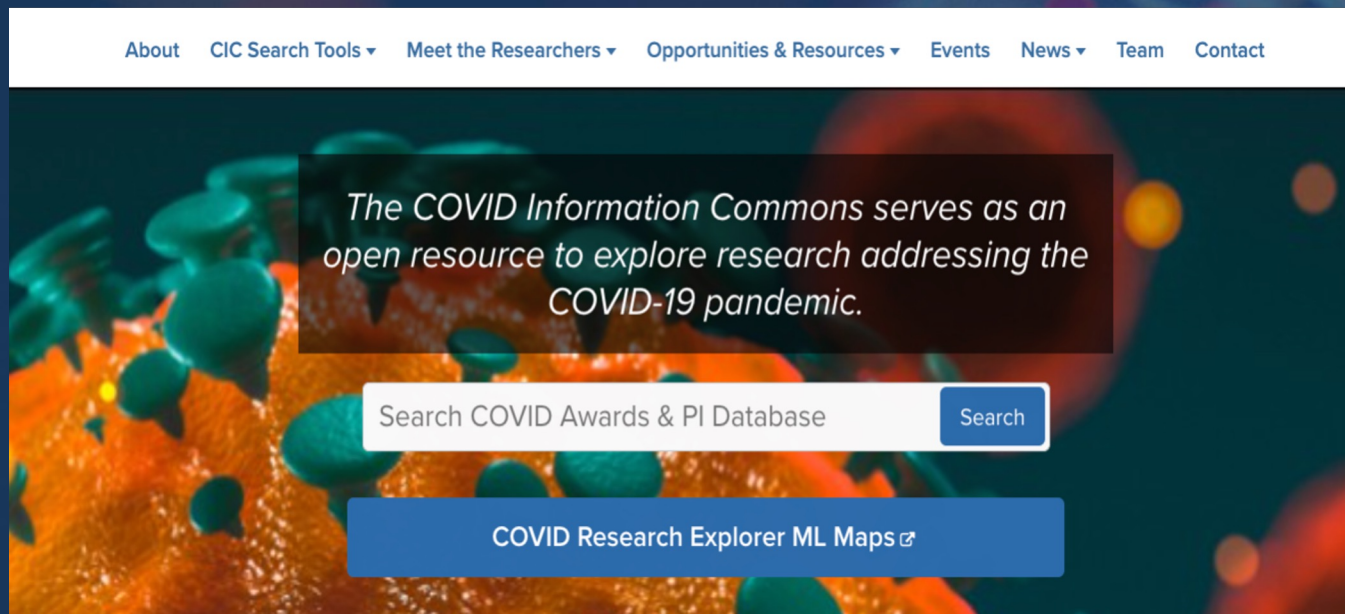
TIPPSS Roadmap Task Group Launched to create new standards opportunities:

- *AI-Based Coaching for Healthcare with TIPPSS*
- *Remote Subject Monitoring for Clinical Trials*
- *Research Infrastructure*
- *Cyberinfrastructure*
- *Distributed Energy Resources / Smart Grid*
- *Connected Vehicles*
- *Smart Cities*
- *Virtual Human Twins*
- *etc.*

Join us! <https://nebigdatahub.org/tippss/>

Develop a Virtual Human Twins Information Commons for Researcher and Practitioner Collaboration

Modeled after the COVID Information Commons (CIC) Portal and Community



Benefits of an Information Commons Portal and Community

- Easily find pertinent research - e.g., 14,000+ NSF/ NIH COVID-related awards, metadata, PI's
- Search by topic, project, PI, institution, funder, location
- Update via NSF and NIH API pulls
- Easily find pertinent datasets and publications
- Build community with research lightning talk webinars, topical working groups
- Post research lightning talks in video library
- Provide PI profiles to inspire collaboration
- Attract tens of thousands of video views
- Inspire student working groups and paper challenges

COVID INFORMATION COMMONS

About CIC Search Tools Meet the Researchers Opportunities & Resources Events News Team Contact

Search

Showing 14033 results for COVID-related grants. To search over other types of content, visit the Advanced Search page. [Download Results as CSV \(up to 500 awards\)](#)

NSF and NIH Projects

Awards	Principal Investigator	Award Amount
NSF 2025 USUCGER Early Career Workshop for Geotechnical Faculty; Atlanta, Georgia; October 2025 This award is to support participants to attend the third United States Universities Council on Geotechnical Education and Research (USUCGER) Early Career Workshop that will be held in October 2025 in collaboration with the Geosystems Engineering fa... SHOW MORE	Susan Burns	\$50,000
NSF Integrating Soft Skills with Technical Skills to Produce Next-Generation Cybersecurity Technicians This project aims to serve the national interest by producing more...	Alan Gruver	\$565,044

Filter Results [CLEAR FILTER](#)

Funder NSF Directorate NIH Institute/Center Awardee Organization State/Territory PI Name Program Officer/Official Start/End Date

<https://covidinfocommons.net/>

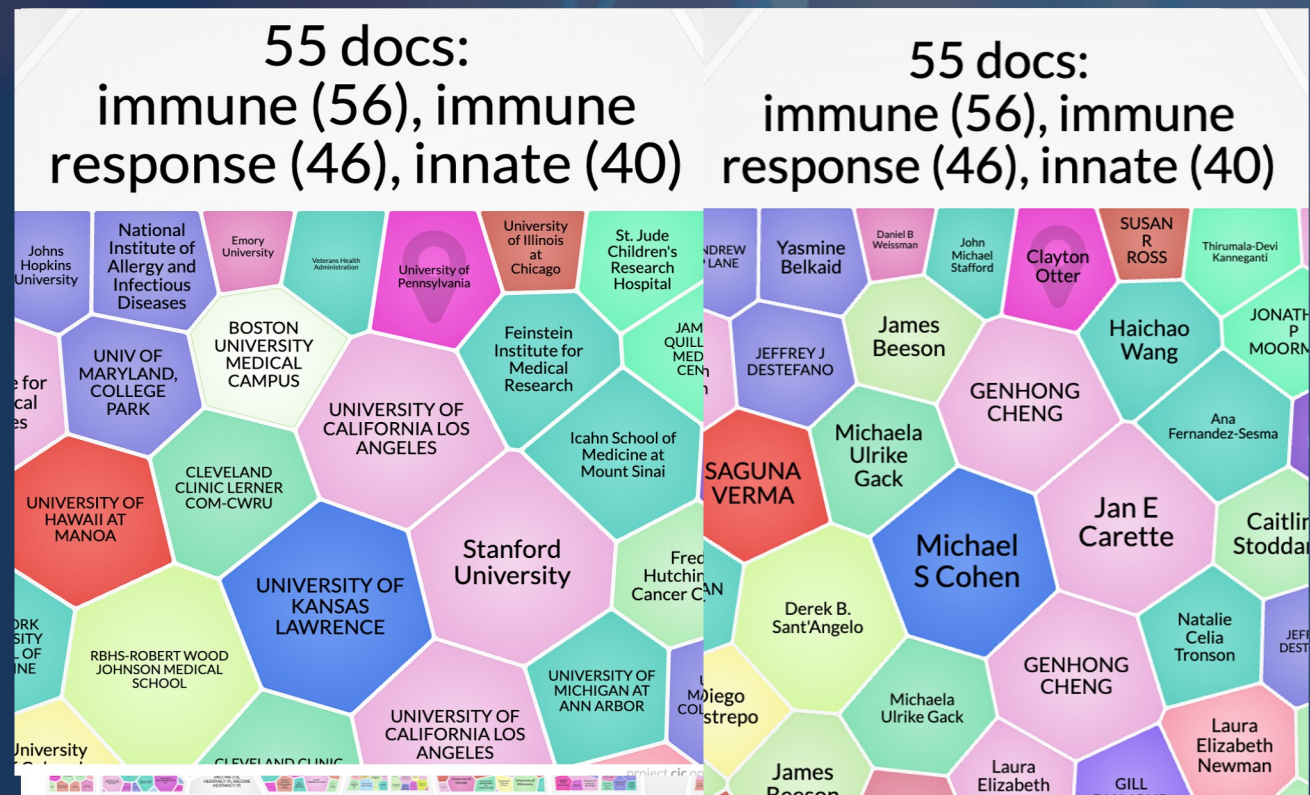
COVID Information Commons - COVID Research Explorer ML Maps Clustering Tool

Architected for visualization of
NSF and NIH funded COVID
projects, with drill down

Maps COVID research and
researchers by topic, Principal
Investigator, Institution, or State

Users can input keyword queries
to focus on target domains

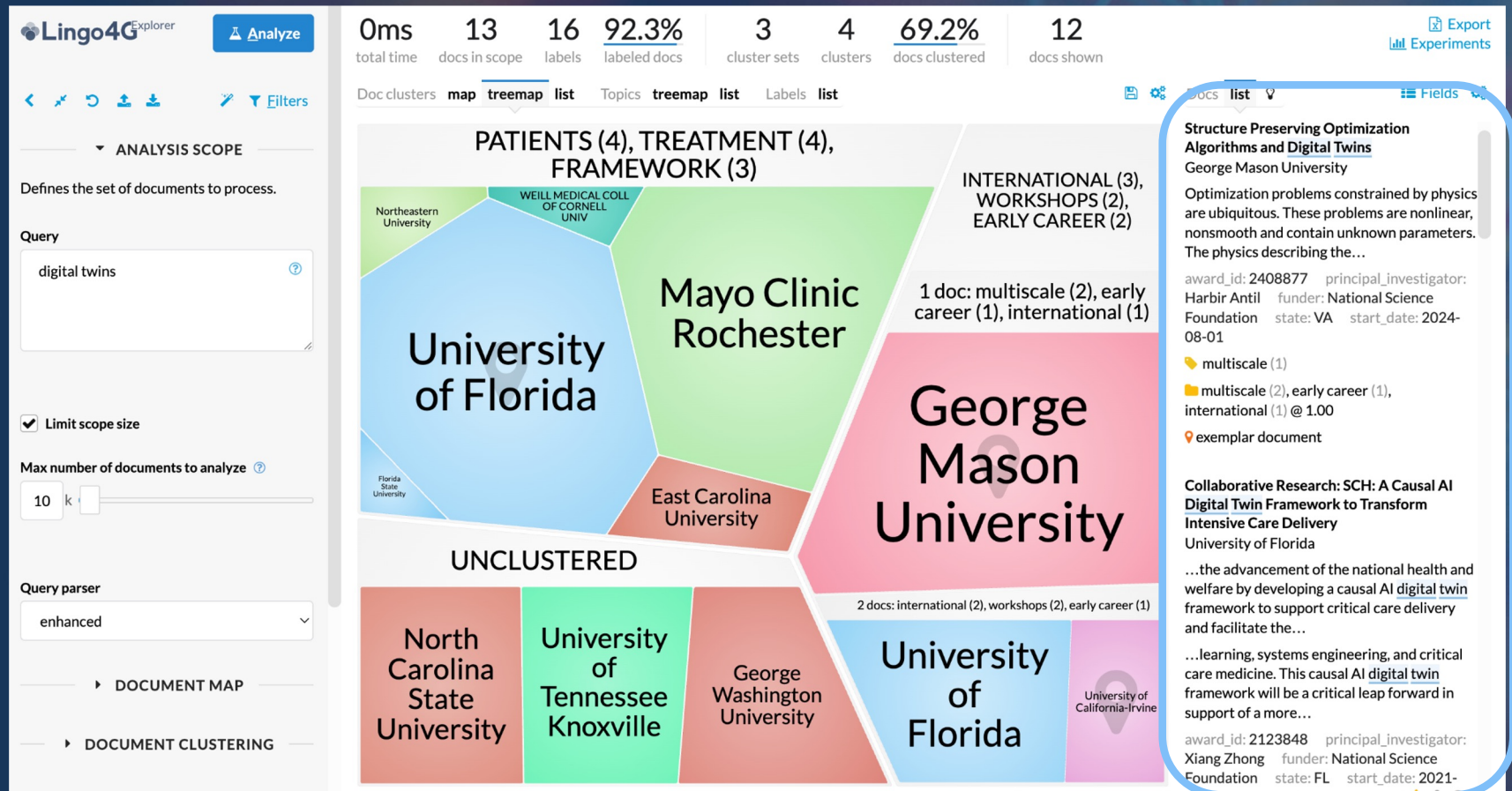
Find research, PIs, publications,
datasets, funders, and more



<https://covidinfocommons.net/>

Sample NSF and NIH Digital Twins Awards in the CIC -

We could create a Virtual Human Twins Info Commons



Proposed we collaborate to accelerate adoption of Virtual Human Twins in Healthcare

1. *Develop a TIPPS initiative for Virtual Human Twins to help increase Trust, Identity, Privacy, Protection, Safety and Security of the twins, data, devices, humans, research, institutions.*
1. *Build a Virtual Human Twins Knowledge Network, including an Information Commons Portal and Community to enable:*
 - *Research, researcher and practitioner discovery and collaboration*
 - *Data and knowledge interoperability and sharing*
 - *Community development with lightning talks, webinars, videos, working groups, student projects*
 - *Examples of applications of Virtual Human Twins in practice.*





Q&A

Thank you

Florence D. Hudson
Executive Director,

Northeast Big Data Innovation Hub at Columbia University

florence.hudson@columbia.edu

Find the TIPPSS books and papers here - <https://fdhint.com/writing>