

# TIPSS to address data-related challenges in development & deployment of digital twins

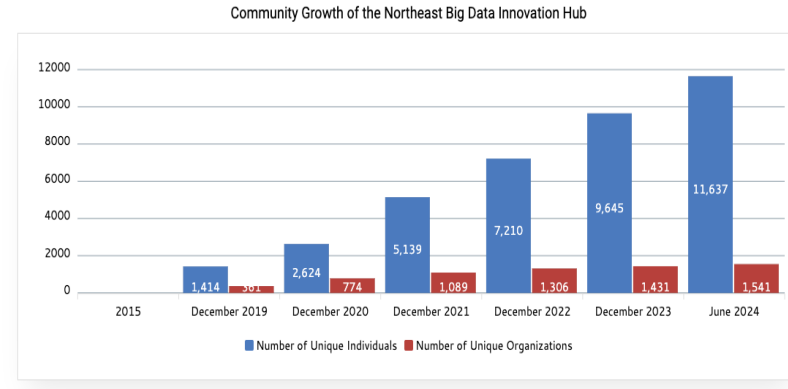
New York Scientific Data Summit 2024: Addressing Data Challenges in Digital Twins  
SUNY Global Center, NYC  
September 16, 2024

Florence D. Hudson, Executive Director, Columbia University  
PI NSF Northeast Big Data Innovation Hub, COVID Information Commons, Proto-OKN  
Founder & CEO, [FDHint](#), LLC; Editor & Author; IEEE Engineering in Medicine & Biology Society

# Northeast Big Data Innovation Hub

- ***Established in 2015 as a community convener, collaboration hub, and catalyst for data science awareness, education and innovation.***
- Our mission is to build a diverse, equitable, and inclusive community for data science learners, educators, researchers and professionals with open, free, online, accessible resources.
- 11,637 individuals from 1,541 organizations, in all 50 U.S. States, plus Puerto Rico, Washington, D.C., and 62 other countries! *Grew 8X since 2019!*

## An Overview of our Community



# Northeast Big Data Innovation Hub Focus Areas



## Education & Data Literacy

National Student Data Corps (NSDC)

NSDC Global Chapter Community

Data Science Resource Repository (DSRR)

Data Science Flashcard Series



## Health

COVID Information Commons (CIC)

CIC Student Paper Challenge

CIC Working Groups

AIM-AHEAD Data Science Training Core Portal



## Urban to Rural Communities

Transportation Data Science Project (TDSP)

Climate and Nature

Smart Cities Data Exchange

Driver Video Privacy Challenge



## Responsible Data Science

Security, Privacy & Ethics

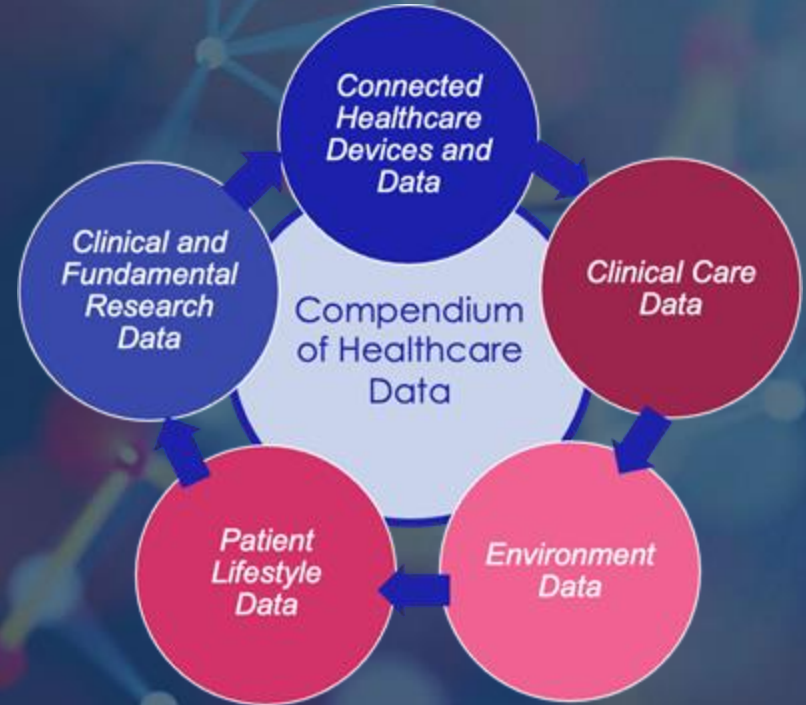
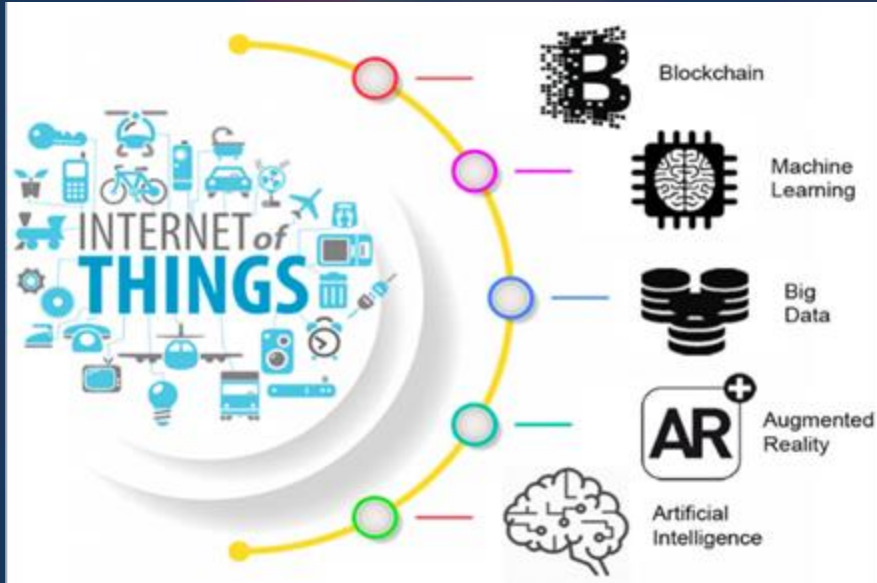
Responsible Data Science Comic Books

IEEE/UL 2933 TIPPSS Standard Working Group

IEEE Cybersecurity TIPPSS for Industry 2024 Workshop Series

IEEE Connected Healthcare Cybersecurity 2021 Workshops

# Leveraging advanced technologies and data can improve insights and outcomes, enable precision medicine



# However, more devices and data 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*



# Increased connectivity brings increased risk... What could possibly go wrong? ...

US Food and Drug Administration (FDA) identified software vulnerabilities that could let hackers take advantage of personal medical devices dating back as far as 2008.

## **2017 - FDA Recalled 465,000 pacemakers due to cyber hacking fears.**

- Hackers could reprogram 20 types of devices with adjacent access/low skill level.
- RF Telemetry protocol utilized did not implement encryption.

**2018 - FDA announced "voluntary recall" of certain internet-connected programmers for implantable cardiac devices due to cybersecurity vulnerabilities, and certain insulin pumps.**

**2019 - FDA recalled 80,000 insulin pumps due to hacking fears.**

Sources: <https://www.careersinfosecurity.asia/medtronic-cardiac-devices-recalled-due-to-cyber-concerns-a-11597>,  
<https://www.theguardian.com/technology/2017/aug/31/hacking-risk-recall-pacemakers-patient-death-fears-fda-firmware-update>,  
<https://www.fda.gov/medical-devices/medical-device-recalls/medtronic-recalls-remote-controllers-used-paradigm-and-508-minimed-insulin-pumps-potential>

# We must secure connected 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>

# TIPSS 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.







# IEEE 2933™-2024 Standard for Clinical (IoT) Data & Device Interoperability with TIPPSS

*Purpose: This standard establishes the framework with TIPPSS principles (Trust, Identity, Privacy, Protection, Safety, Security) for Clinical Internet of Things (IoT) data and device validation and interoperability. This includes wearable clinical IoT and interoperability with healthcare systems including Electronic Health Records (EHR), Electronic Medical Records (EMR), other clinical IoT devices, in-hospital devices, and future devices and connected healthcare systems.*

- *Standard Approved by IEEE and UL in June 2024, to be published October 2024*
- *New IEEE initiative for TIPPSS for Remote Subject Monitoring – join the team!*
- *IEEE 2933 Working Group is a 2024 IEEE Emerging Technology Awardee*

# COVID Information Commons (CIC) - Portal and Community

*Consider a Digital Twin Information Commons for  
Researcher and Practitioner Collaboration*



The screenshot shows the homepage of the COVID Information Commons. At the top is a navigation menu with links: About, CIC Search Tools, Meet the Researchers, Opportunities & Resources, Events, News, Team, and Contact. The main content area features a dark background with a 3D molecular model of a virus. A white text box in the center contains the text: "The COVID Information Commons serves as an open resource to explore research addressing the COVID-19 pandemic." Below this is a search bar with the placeholder text "Search COVID Awards & PI Database" and a blue "Search" button. At the bottom, there is a blue button labeled "COVID Research Explorer ML Maps".

# COVID Awards and Researcher (PI) Database

CIC Database includes 13,000+ NSF & NIH COVID-related awards, metadata and PI info. Search the database by project name, topic, PI name, institution, funder, location.

COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK

## COVID INFORMATION COMMONS

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

Search

Showing 13312 results. [Download Results as CSV \(up to 500 awards\)](#)

| Awards  | Principal Investigator        | Award Amount |
|---|-------------------------------|--------------|
| <p><b>NSF</b><br/> <a href="#">Postdoctoral Fellowship: PRFB: Understanding the impacts of simultaneous stressors on bat immunity and spillover risks</a><br/>                     This action funds an NSF Postdoctoral Research Fellowship in Biology for FY 2024, Integrative Research Investigating the Rules of Life Governing Interactions Between Genomes, Environment, and Phenotypes. The fellowship supports research and training...<a href="#">SHOW MORE</a></p>                        | <a href="#">Molly Simonis</a> | \$240,000    |
| <p><b>NSF</b><br/> <a href="#">NSF PRFB FY 2023: Understanding the ecological drivers and genomic mechanisms of wildlife viral emergence caused by deforestation in Cambodia</a><br/>                     This action funds an NSF Postdoctoral Research Fellowship in Biology for FY 2023, Integrative Research Investigating the Rules of Life Governing Interactions Between Genomes, Environment, and Phenotypes. The fellowship supports research and training...<a href="#">SHOW MORE</a></p> | <a href="#">Cong Xu</a>       | \$240,000    |

Filter Results CLEAR FILTER

Funder ▼

NSF Directorate ▼

NIH Institute/Center ▼

Awardee Organization ▼

State/Territory ▼

PI Name ▼

Program Officer/Official ▼

Start/End Date ▼

# NSF + NIH COVID Awards and PI Profiles

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## COVID INFORMATION COMMONS

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

**NSF**  
Award Abstract #2009391

### CIC-E: COVID Information Commons Extension for Pandemic Recovery

See grant description on NSF site

**Program Manager:**  
Mike Pozmantier

**Active Dates:**  
Oct. 1, 2021 – Sept. 30, 2025

**Awarded Amount:**  
\$2,000,000

**Investigator(s):**  
Florence D Hudson  
Jeannette Wing

**Awardee Organization:**  
Columbia University  
New York

**Funder Division:**  
Technology Innovation and Partnerships (TIP)

**Abstract:**  
The COVID Information Commons, CIC (<http://covidinfocommons.datascience.columbia.edu/>), was established in May 2020 via an NSF COVID Rapid from all COVID-related projects funded by the various Directorates across NSF in order to create a easily searchable corpus. In addition to the publicly COVID RAPID research projects. The CIC Extension will extend this initial CIC effort to also include all projects funded by NSF related to the pandemic bringing together information about a diverse set of COVID-related projects into a single place, thereby enabling interested users to efficiently search include projects in the pandemic recovery phase, and will additionally incorporate contemporary ways of interacting with the information such as via COVID Information Commons, which pulls together publicly available information along with voluntary self-report information on NSF-funded COVID collaborations among researchers from diverse scientific disciplines and from different parts of the country drawn together by their common interest facilitate networking among researchers engaged in COVID-related research. The CIC Extension will also build upon and expand the successful research Law 117-2). This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual

COVID INFORMATION COMMONS

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### Florence D Hudson

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Website: <https://covidinfocommons.net>  
<https://webigdatahub.org/about/>



**COVID-19 Research Lightning Talk: Florence Hudson, Columbia University**

**COVID Information Commons Events**

**Florence Hudson, Northeast Bio Data Innovation Hub**

**COVID Research Explorer Machine Learning Maps**

Awardee COVID Grant:  
CIC-E: COVID Information Commons Extension for Pandemic Recovery  
RAPID: COVID Information Commons (CIC)

Keywords:  
Data science | analytics | health | COVID | coronavirus | cybersecurity | connected healthcare | Medical Internet of Things | IoT | TPPSS



# Digital Twins NSF and NIH Awards in the CIC

**Lingo4G** Explorer Analyze

find settings, e.g. 'overlap' ×

ANALYSIS SCOPE

Defines the set of documents to process.

Query

digital twins

Limit scope size

Query parser

enhanced

DOCUMENT MAP

Configuration of the documents 2d map.

Document similarity type

Label embedding centroids

More Like This similarity

Max similar documents

8

52ms 10 19 100% 2 2 90.0%

total time docs in scope labels labeled docs cluster sets clusters docs clustered

Doc clusters map treemap list Topics treemap list Labels list

## DIGITAL (9), TWIN (9), NETWORK (5)

## UNCLUSTERED

# Mayo Clinic Rochester

award\_id: 2123900 principal\_investigator: Phillip Schulte awardee\_organization: Mayo Clinic Rochester funder: National Science Foundation state: MN

care (12) patients (8) critical care (8) care delivery (8) twin (5)

**Collaborative Research: SCH: A Causal AI Digital Twin Framework to Transform Intensive Care Delivery**

This Smart and Connected Health (SCH) award will contribute to the advancement of the national health and welfare by developing a causal AI digital twin framework to support critical care delivery and facilitate the realization of "Healthcare 4.0." Critical illness from sepsis and pneumonia is the leading cause of in-hospital mortality and a global health priority. While early diagnosis and error-free treatment consistently achieve good outcomes, the progression of critical illness to multiple organ failure often translates to either death or loss of independence. The COVID-19 pandemic have exposed long standing deficiencies in critical care knowledge and practice in hospital worldwide....

award\_id: 2123900 principal\_investigator: Phillip Schulte awardee\_organization: Mayo Clinic Rochester funder: National Science Foundation state: MN

care (12) patients (8) critical care (8) care delivery (8) twin (5)

# COVID INFORMATION COMMONS

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

COVID Awards & Researcher Database

**13,300 awards + PIs**

COVID Research Explorer ML Maps

Create or Enhance your COVID PI profile

API documentation

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

COVID-19 Research Lightning Talks

**141 Lightning Talks**

Register for the Next CIC Webinar

**29 webinars**

Video Library

5 Questions with COVID Researchers

**13,800 YouTube views + 1,300 Live Attendees**

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

Career & Professional Opportunities

CIC Student Paper Challenge

**20 student winners**

COVID Publications

Datasets

**140+ COVID publications, groups, guides, datasets, funding sources**

Groups & Guides

Research Funding

Spanish Language Resources & Outreach

Student Working Group

**750 students in CIC WG**

# Key takeaways

Develop a TIPPSS initiative for biomedical digital twins to increase Trust, Identity, Privacy, Protection, Safety and Security of the data, devices, humans, research, institutions

Build a Biomedical Digital Twins Information Commons Portal and Community, leveraging FAIR principles for Findable, Accessible, Interoperable, Reusable data and research, to enable:

- Research discovery
- Researcher collaboration
- Data sharing
- Lightning talks, webinars, working groups, student projects
- Student and professional development
- Application of the research to practice





# Q&A

*Thank you!*

Florence D. Hudson

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<https://www.himss.org/what-we-do-opportunities/health-information-and-technology-awards>

