# RADx Rad Discovery & Data Consortium Coordination Center & Program Organization

Introduction and Q&A

# Multiple PIs

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Infectious Diseases, User Centered Design, Diagnostics & Informatics

Privacy Technology, Predictive Modeling, Evaluation Methods

Data Representation, Biomedical Natural Language Processing
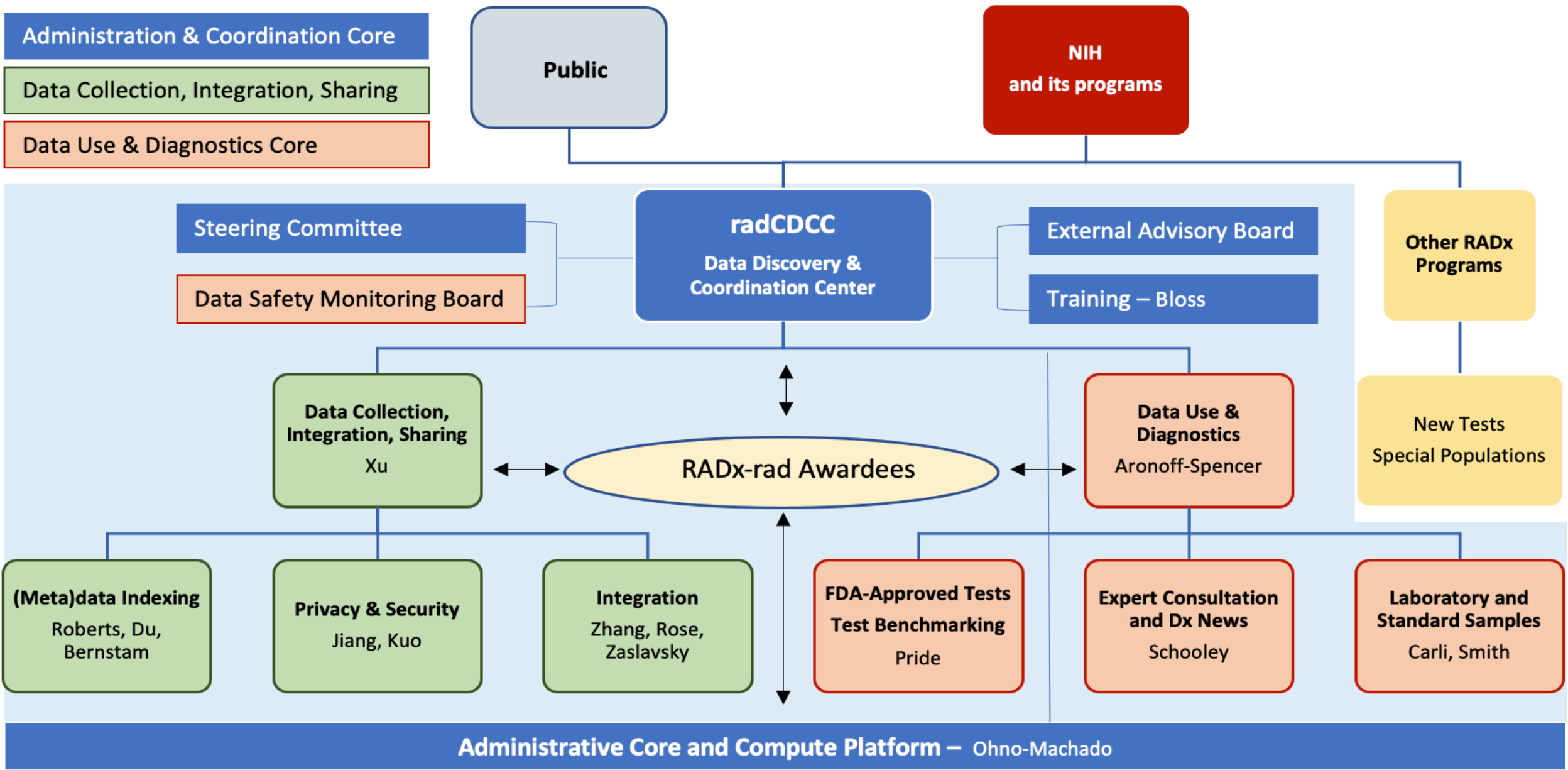
| FOA | # | Title | Institution |
|---|---|---|---|
| PA-20-272 and NOT-OD-21-035 | 6 | Virus Counter: Rapid and Sensitive Diagnostics Based on Digital Detection of Individual Pathogens | Boston University |
| PA-20-272 and NOT-OD-21-035 | 6 | MOF-SCENT: Metal-organic Frameworks for Screening COVID-19 by Electronic-Nose Technology to Improve Selectivity and Time Response | Missouri University of Science and Technology |
| PA-20-272 and NOT-OD-21-035 | 6 | Broad-spectrum Detection of VOC and Non-VOC Biomarkers from Patient Exhalant using Biomimetic Multiplexed eNose Biosensor for COVID-19 Diagnosis | University of Washington |
| PA-20-272 and NOT-OD-21-035 | 6 | A Rapid Saliva Antigen Test for SARS-CoV-2 Detection | Brigham and Women's Hospital |
| PA-20-272 and NOT-OD-21-035 | 6 | A Rapid Breathalyzer Diagnostics Platform for COVID-19 | Rutgers University |
| PA-20-272 and NOT-OD-21-035 | 6 | RADx-rad: A Rapid, Sensitive, Point-of-care, Antigen-based Diagnostics for SARS-CoV-2 | Boston Biomedical Innovation Center (B-BIC) |
| RFA-OD-20-014 | 6 | Nanobody-based Electrochemical Biosensor for Real-Time Detection of Aerosolized SARS-CoV-2 | Washington University |
| RFA-OD-20-014 | 6 | Detection and Automatic Privacy-Protected Contact Tracing System Designed for COVID-19 | Louisiana State Univ A&M Col Baton Rouge |
| RFA-OD-20-014 | 6 | Rolosense: An Innovative Platform for Automatic Mobile Phone Readout of Active SARS-CoV-2 Particles | Emory University |
| RFA-OD-20-014 | 6 | Minimal False-alarm Touch-based Detection of SARS-CoV-2 Virus Particles using Poly-aptamers | General Electric Global Research Center |
| RFA-OD-20-014 | 6 | Touchscreen-compatible, Real-Time Electrochemical Sensing of SARS-CoV-2 | University of Washington |
| RFA-OD-20-014 | 6 | Development of an Automated Diagnostic Platform for SARS-CoV-2 Monitoring in Vulnerable Areas | Clemson University |
| RFA-OD-20-015 | 6 | Development and Proof-of-Concept Implementation of the South Florida Miami RADx-rad SARS-CoV-2 Wastewater-Based Surveillance Infrastructure | University of Miami Coral Gables |
| RFA-OD-20-015 | 6 | Wastewater Analysis of SARS CoV-2 in Tribal Communities | Arizona State University-Tempe |
| RFA-OD-20-015 | 6 | Improved Scalability, Sensitivity, and Interpretability of Pathogen Detection, Including SARS-CoV-2, in Wastewater using High-Throughput, Highly Multiplexed Digital Array PCR Technology | University of North Carolina, Chapel Hill |
| RFA-OD-20-015 | 6 | Wastewater Assessment for Coronavirus in Kentucky: Implementing Enhanced Surveillance Technology | University of Kentucky |
| RFA-OD-20-015 | 6 | Wastewater Detection of COVID-19 | Missouri State Dept/ Health & Senior Services |
| RFA-OD-20-015 | 6 | Optimizing SARS-CoV-2 Wastewater Based Surveillance in Urban and University Campus Settings | Columbia University Health Sciences |
| RFA-OD-20-016 | 4 | Marshallese: Alternate Surveillance for COVID-19 in a Unique Population | Washington State University |
| RFA-OD-20-016 | 4 | Validation of Smart Masks for Surveillance of COVID-19 | University of California, San Diego |
| RFA-OD-20-016 | 4 | Multi-modal Wireless COVID Monitoring & Infection Alerts for Concentrated Populations | Stanford University |
| RFA-OD-20-016 | 4 | Early Detection, Containment, and Management of COVID-19 in Dialysis Facilities Using Multi-Modal Data Sources | University of California, Santa Barbara |
| RFA-OD-20-017 | 4 | Portable GC Detector for Breath-based COVID Diagnostics | University of California, Davis |
| RFA-OD-20-017 | 4 | COVID-19 Detection through Scent Analysis with a Compact GC Device | University of Michigan at Ann Arbor |
| RFA-OD-20-017 | 4 | A Handheld Microchip for GC Analysis of Breath to Screen for COVID-19 | University of Louisville |
| RFA-OD-20-017 | 4 | Effective, Reagent-free Detection of the Odor Signature of Covid-19 Infection Using a Nano-Enabled Sensor Array | University of Pennsylvania |
| RFA-OD-20-018 | 4 | Multi-parametric Integrated Molecular Detection of SARS-CoV-2 from Biofluids by Adapting Single Extracellular Vesicle Characterization Technologies | Ohio State University |
| RFA-OD-20-018 | 4 | AFS/SERS Saliva-based SARS-CoV-2 Earliest Infection and Antibodies Detection | University of California, Los Angeles |
| RFA-OD-20-018 | 4 | Exosome-based Non-traditional Technologies Towards Multi-Parametric and Integrated Approaches for SARS-CoV-2 | Johns Hopkins University |
| RFA-OD-20-018 | 4 | Microfluidic Isolation and Characterization of SARS-CoV-2 and Virus Related Exosomes | Massachusetts General Hospital |
| RFA-OD-20-020 | 3 | A Scalable Aptamer-based Electrochemical Biosensor for Rapid Detection of SARS-Cov-2 from Saliva | mPOD, Inc. |
| RFA-OD-20-020 | 3 | Designer DNA Nanostructure Based Biosensing for Rapid COVID-19 Detection and Monitoring using Saliva Sample | Atom Bioworks, Inc. |
| RFA-OD-20-020 | 3 | Direct Bioelectronic Detection of SARS-Cov-2 from Saliva using Singlemolecule Field-effect Transistor Array | Quicksilver Biosciences, Inc. |
| RFA-OD-20-021 | 2 | A Multimodal Platform for Oral Screening of COVID-19 | Innotech, LLC |
| RFA-OD-20-021 | 2 | A SARS-CoV-2 Breathalyzer for Direct Virus Detection | Aerosol Devices, Inc. |
| RFA-OD-20-022 | 3 | SCENTinel: A Rapid Smell Test for COVID-19 Surveillance | Monell Chemical Senses Center |
| RFA-OD-20-022 | 3 | Rapid Olfactory Tools for Telemedicine-friendly COVID-19 Screening and Surveillance | University of Florida |
| RFA-OD-20-022 | 3 | Longitudinal at Home Smell Testing to Detect Infection by SARS-CoV-2 | ADK Group, LLC |

49 AWARDEES     13 FOAS

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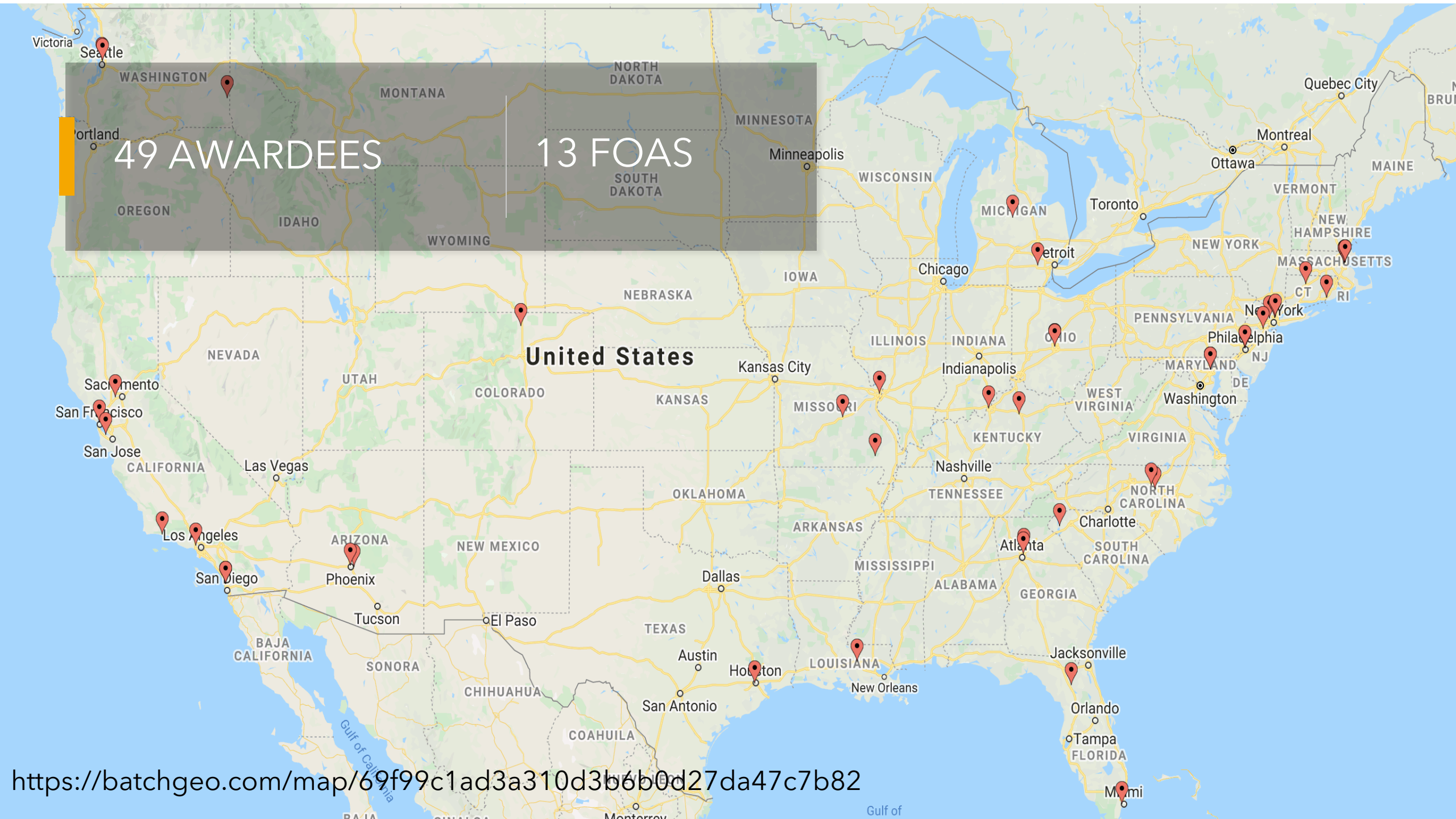
# Awardees

**SCENT**
- University of California, Davis
- University of Michigan at Ann Arbor
- University of Louisville
- University of Pennsylvania

**VOC Detection**
- Boston University
- Missouri University of Science and Technology
- University of Washington
- Brigham and Women's Hospital
- Rutgers University
- Boston Biomedical Innovation Center (B-BIC)

- National Institute of Environmental Health Sciences

**PreVAIL kID**S
- University of California, San Diego
- Johns Hopkins University
- Baylor College Of Medicine
- Children's Hospital of Philadelphia
- Central Michigan University
- Connecticut Children's Medical Center
- Robert Wood Johnson Medical School
- University of California, San Francisco

**Exosome-based**
- Ohio State University
- University of California, Los Angeles
- Johns Hopkins University
- Massachusetts General Hospital

# Awardees

## 🔵 Wastewater
- Arizona State University
- University of Miami Coral Gables
- ASU-Tempe
- UNC Chapel Hill
- U Kentucky
- Missouri Dept/ Health & Senior Services
- Columbia University

## 🟢 Biosensor Detection/Tracing
- Washington University
- Louisiana State Univ A&M Col Baton Rouge
- Emory University
- General Electric Global Research Center (GA)
- University of Washington
- Clemson University

## 🔴 Novel Biosensing
- mPOD, Inc. (NY)
- Atom Bioworks, Inc. (NC)
- Quicksilver Biosciences, Inc. (NY)
- Innotech, LLC (RI)
- Aerosol Devices, Inc. (CO)

## 🟡 Chemosensory Testing
- Ohio State University
- Monell Chemical Senses Center (PA)
- University of Florida
- ADK Group, LLC (MA)

## 🟣 Multimodal Surveillance
- Washington State University
- UC San Diego
- Stanford
- UC Santa Barbara

# ADMINISTRATION & COORDINATION  CORE

# Data Sharing to Accelerate Research

Large quantities of data are needed for statistical significance, AI models, etc.

Testing data can be sensitive, and 'de-identification' techniques do not always protect privacy

Research is competitive, and researchers want to quality control their data and be first to analyze the data

# Activities Planned

- Survey NIH and Awardees for Needs Analysis – done, new one on CDEs next week

- Monthly all-hands calls - second Monday 10-11am Pacific Time **March 8** start

- Bi-Monthly Steering Committee call – POs & PI representatives

- Weekly technical office-hours – Pacific Times

  - IRB          Wednesdays 8-9am
  - Data          Thursdays 1-2pm
  - Diagnostics Thursdays 10-11am

- Optional Training in Data Transformation, Teamwork, Anti-Racism – 1 training per semester

- Web portal with News, Awardee Highlights, Resource requests - March

# RADx-rad Program



**Awardee**
collect
identified data

**Awardee**
generate
de-identified data

**Awardee**
generate
comparable data

guidance on
CDEs
de-identification
generation of RADx-rad ID

submission of
de-identified data

standard viral samples
test benchmarking

**RADx-rad
DCC**

data integration,
harmonization, and
sharing

submission of
curated data

**NIH RADx
Data Hub**

All RADx Data

# DATA CORE

# De-Identification Checklist

☐ (1) Names

☐ (2) All geographic subdivisions smaller than a state, including street address, city, county, precinct, ZIP code, and their equivalent geocodes, except for the initial three digits of the ZIP code if, according to the current publicly available data from the Bureau of the Census:

    ☐ (1) The geographic unit formed by combining all ZIP codes with the same three initial digits contains more than 20,000 people; and

    ☐ (2) The initial three digits of a ZIP code for all such geographic units containing 20,000 or fewer people is changed to 000

☐ (3) All elements of dates (except year) for dates that are directly related to an individual, including birth date, admission date, discharge date, death date, and all ages over 89 and all elements of dates (including year) indicative of such age, except that such ages and elements may be aggregated into a single category of age 90 or older

☐ (4) Telephone numbers

☐ (5) Fax numbers

☐ (6) Email addresses

☐ (7) Social security numbers

☐ (8) Medical record numbers

☐ (9) Health plan beneficiary numbers and insurance ID numbers

☐ (10) Account numbers

☐ (11) Certificate/license numbers

☐ (12) Serial numbers, including vehicle identifiers and license plate numbers

☐ (13) Device identifiers

☐ (14) Web Universal Resource Locators (URLs)

☐ (15) Internet Protocol (IP) addresses

☐ (16) Biometric identifiers, including finger and voice prints

☐ (17) Full-face photographs and any comparable images

☐ (18) Any other unique identifying number, characteristic, or code, except as permitted by paragraph (c) of this section [Paragraph (c) is presented below in the section "Re-identification"]

# Common Data Elements (CDEs)

- NIH CDE resources
  - [NIH Common Data Elements Repository](#)
  - [The NIH Public Health Emergency and Disaster Research Response (DR2) resource](#)
  - [PhenX Toolkit](#)

- Current work on CDEs
  - Tier 1 CDEs (minimum CDEs) required by NIH
  - Tier 2 CDEs (recommended) for RADx-UP CDCC, RADx–rad to be discussed
  - Domain-specific CDE recommendations – to be discussed at the FOA level

# Example CDEs required by NIH for human participants

1. IDENTITY Record ID

2A. RACE
What is your race?

Mark one or more boxes AND print origins

☐ American Indian or Alaska Native
☐ Black or African American
☐ Asian
☐ Native Hawaiian or Other Pacific Islande
☐ White
☐ Some other race
☐ Prefer not to answer
(Check all that apply)

2B. ETHNICITY
Are you Hispanic, Latino, or Spanish origin?

No, not of Hispanic, Latino, or Spanish origin
Yes, of Hispanic, Latino or Spanish origin
Prefer not to answer

3. AGE

Age

For babies less than 1 year old, do not write the age
In months. Write 0 as the age.

_____ (Years)

4. SEX What is your biological sex assigned at birth?

Male
Female
Intersex
None of these describe me
Prefer not to answer

6. What type of housing do you live in?

Detached House
Duplex/Triplex
Row House
Low rise housing (1-3 floors)
High rise housing (>3 floors)
Mobile home/trailer
Boat, RV, Van, etc.
Other Specify
Prefer not to answer
Don't know

Specify other household type

7. EMPLOYMENT We would like to know what you do. Are you working now, looking for work, retired, keeping house, a student, or what?

Working now
  Only temporarily laid off, sick leave or maternity leave
Looking for work, unemployed
Retired
 Disabled, permanently or temporarily
Keeping house
Student
Other (Specify)
Prefer not to answer/Don't know

8. INSURANCE Are you currently covered by health insurance or a health coverage plans?

I do NOT have health insurance
I HAVE PRIVATE health insurance (purchased directly or through Employment)
I have PUBLIC health insurance (Medicare, Medicaid, Tricare)

Exclude plans that pay for only one type of Service (such as, nursing home care, accidents, Family planning, or dental care) and plans that only provide extra cash when hospitalized

9. MEDICAL HISTORY Do you currently have any of the following conditions? (Select all that apply)

| Condition | | |
|---|---|---|
| Hypertension (HTN) | Yes | No |
| Immuno-compromised | Yes | No |
| Diabetes | Yes | No |
| Chronic Kidney Disease (CKD) | Yes | No |
| Cancer | Yes | No |
| Cardiovascular disease (CVD) | Yes | No |
| Asthma | Yes | No |
| Chronic obstructive pulmonary disease (COPD) | Yes | No |
| Chronic Lung Disease | Yes | No |
| Depression | Yes | No |
| Alcohol or substance use disorder | Yes | No |
| Other mental health disorder | Yes | No |
| Intravenous Drug Use | Yes | No |
| Other chronic condition (specify) | Yes | No |
| Specify other chronic condition | | |

10. Pregnancy. (https://www.phenxtoolkit.org/protocols/view/240602?origin=search)

Are you Currently Pregnant?

Pregnant
Not Pregnant
Don't know
Refused/Prefer not to answer

11. Alcohol Use: (https://cde.drugabuse.gov/sites/nida_cde/files/Audit-C_2014Mar24.pdf)

How often do you have a drink containing alcohol?

a. Never
b. Monthly or less 2-4 times a month
c. 2-3 times a week
d. 4 or more times a week

# RADx-rad DCC CDEs Workflow

- The use of CDEs should not limit your data collection
  - For variables with existing CDEs, reuse them for data collection
  - For variables without existing CDEs, create new DEs
- RADx-rad DCC will work with you to develop the mappings between study variables and CDEs (existing or new) – a draft plan:
  - Awardees – submit data dictionaries and review potential mappings to CDEs
  - RADx-rad DCC team - a second round of review
  - NIH RADx Data Hub CDEs Working Group – feedback and further review if needed

# CDE Development Workflow for Each FOA Group



Study Dictionaries + Existing CDEs

1. Awardees/DCC meetings by FOA Group

2. Awardee review of CDE mappings

3. DCC review of CDE mappings

4. NIH teams review of CDE mappings

5. Iterative reviews if needed

Common Variables
Mappings
Existing/New CDEs

# A CDE mapping tool is under development

**DCC Team**

Review CDE mappings and suggest new CDEs

**DCC Interface**

**Web-based Mapping Tool**

Ontology + NLP

**AWARDEES**

Submit data dictionary and review suggested mappings to CDEs

**AWARDEE Interface**

**NIH Interface**

**NIH Teams**

Review and approve CDE mappings

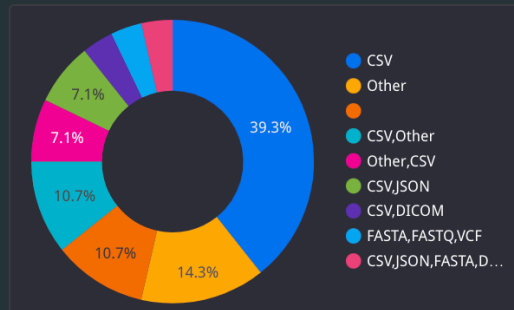# *Data* needs: Preliminary results



RADx RAD Awardee Data Landscape
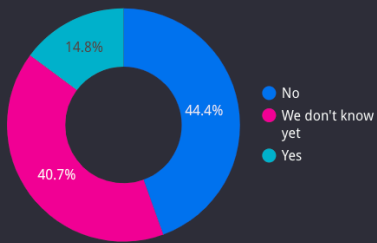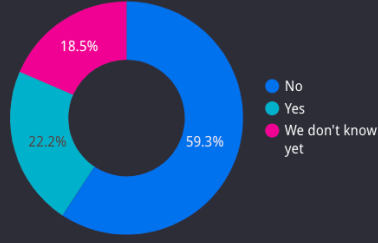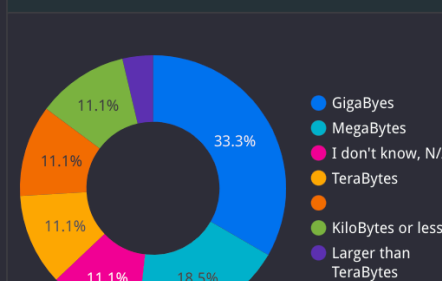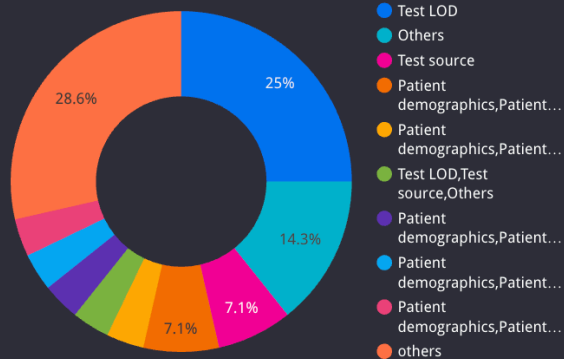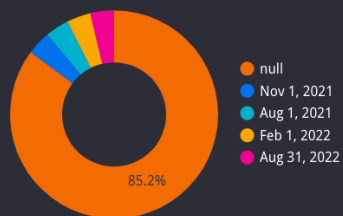
- About a third of awardees anticipate needing help with data analysis, storage and sharing, many are not sure yet

- There is a diversity of data file types, though CSV and JSON are most prevalent

- Data size range from kilobytes to >terabytes

- Earliest data sharing dates start in late 2021

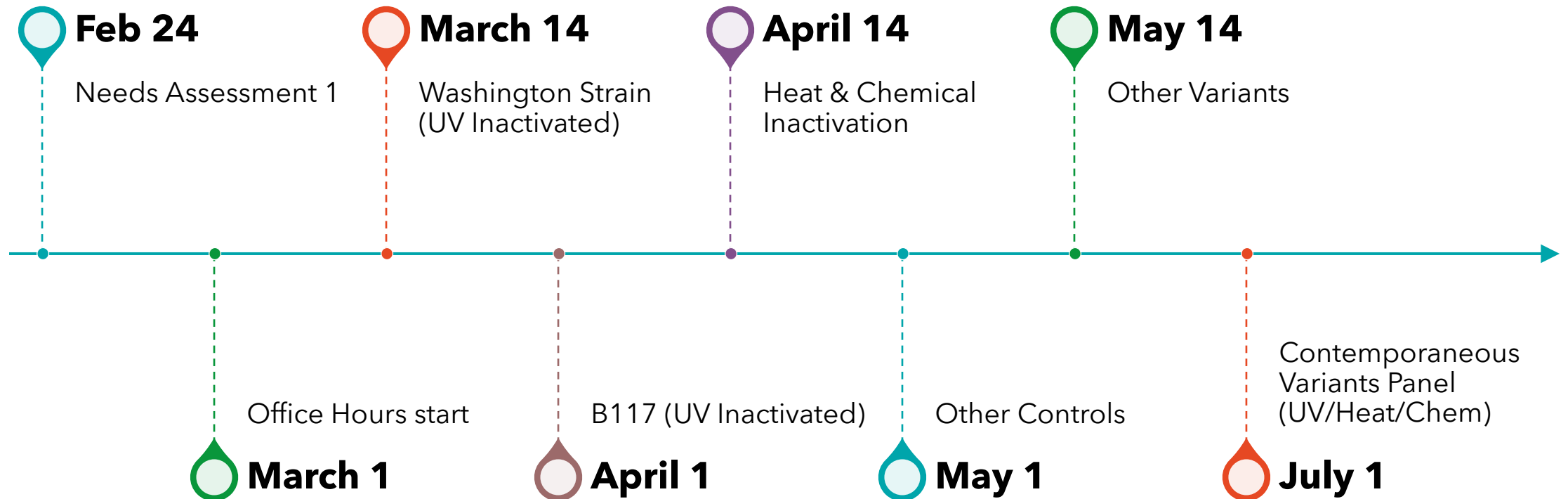- There is a diversity of data types and analysis tools used: most common ones are Matlab, Python, R
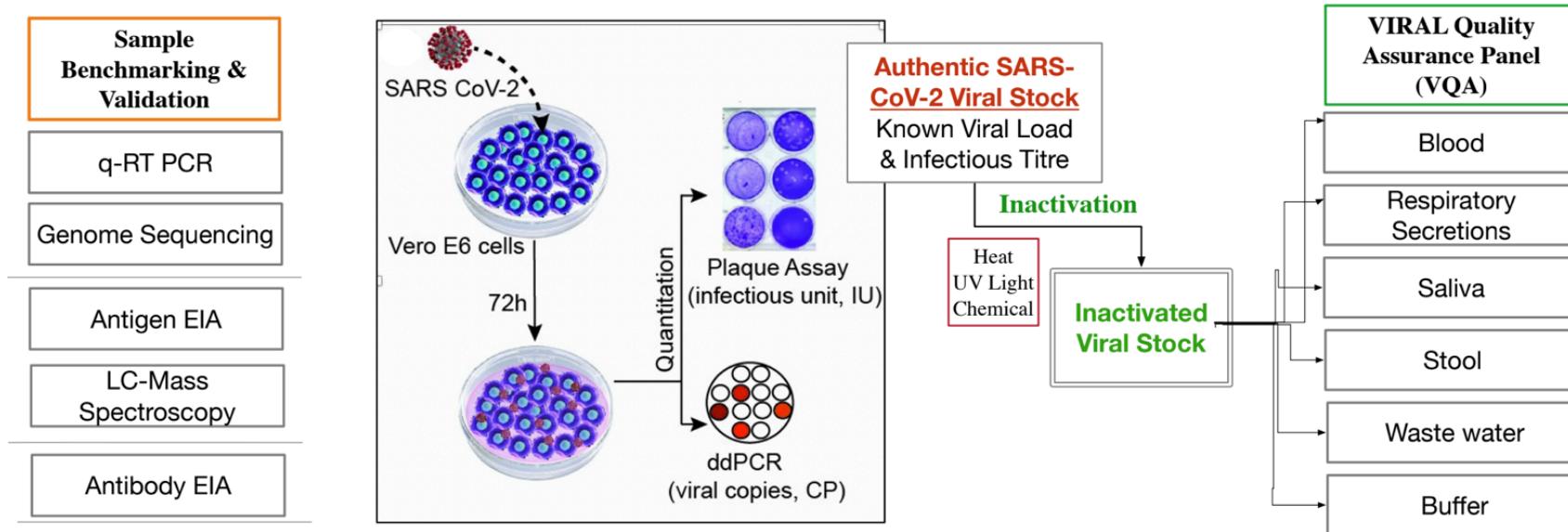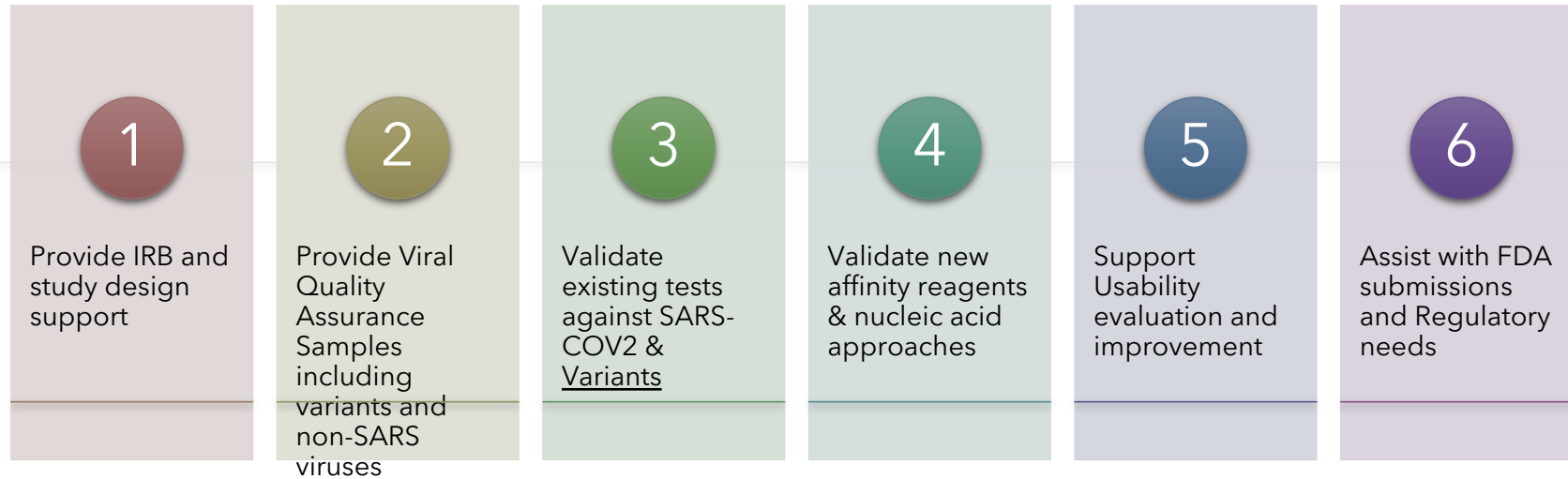
# DISCOVERY & DIAGNOSTICS CORE

# Viral Standards Timeline



**Feb 24** — Needs Assessment 1

**March 1** — Office Hours start

**March 14** — Washington Strain (UV Inactivated)

**April 1** — B117 (UV Inactivated)

**April 14** — Heat & Chemical Inactivation

**May 1** — Other Controls

**May 14** — Other Variants

**July 1** — Contemporaneous Variants Panel (UV/Heat/Chem)

# Viral Stocks, Variants & Diagnostic Support

| **1** | **2** | **3** | **4** | **5** | **6** |
|---|---|---|---|---|---|
| Provide IRB and study design support | Provide Viral Quality Assurance Samples including variants and non-SARS viruses | Validate existing tests against SARS-COV2 & Variants | Validate new affinity reagents & nucleic acid approaches | Support Usability evaluation and improvement | Assist with FDA submissions and Regulatory needs |

**Sample Benchmarking & Validation**

- q-RT PCR
- Genome Sequencing
- Antigen EIA
- LC-Mass Spectroscopy
- Antibody EIA

SARS CoV-2

Vero E6 cells

72h

Quantitation

Plaque Assay (infectious unit, IU)

ddPCR (viral copies, CP)

**Authentic SARS-CoV-2 Viral Stock**
Known Viral Load & Infectious Titre

**Inactivation**

Heat UV Light Chemical

**Inactivated Viral Stock**

**VIRAL Quality Assurance Panel (VQA)**

- Blood
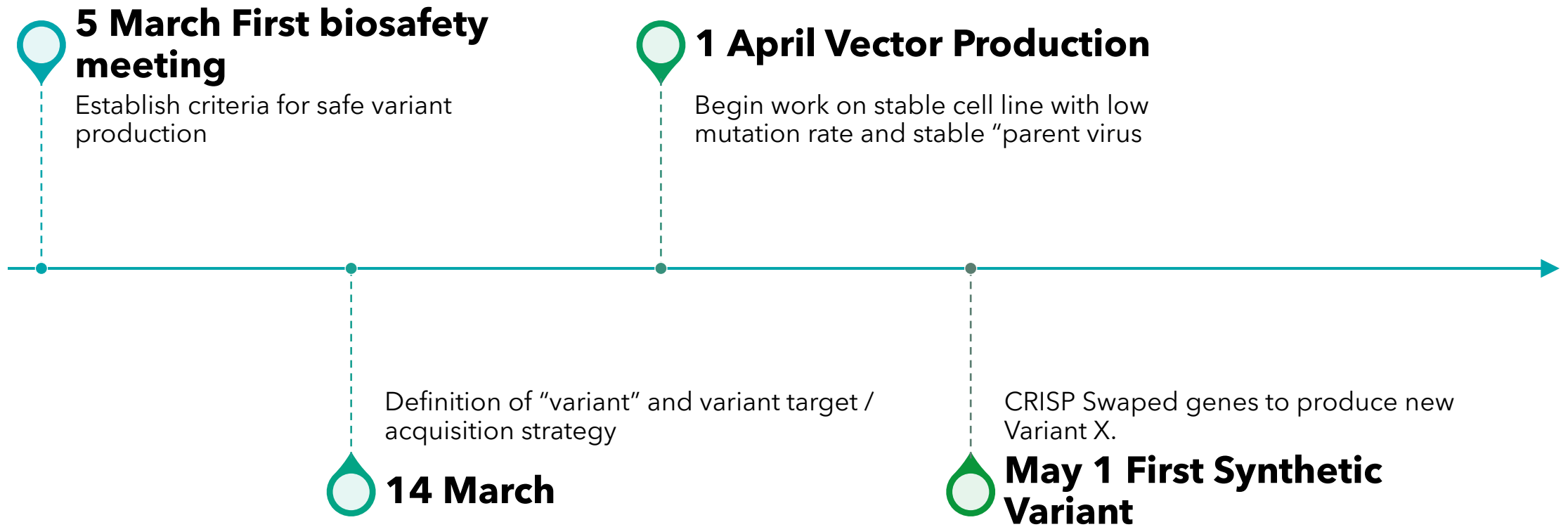- Respiratory Secretions
- Saliva
- Stool
- Waste water
- Buffer

# Variant strategy: staying ahead, scaling

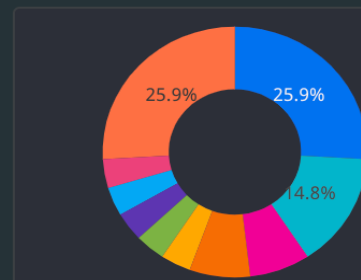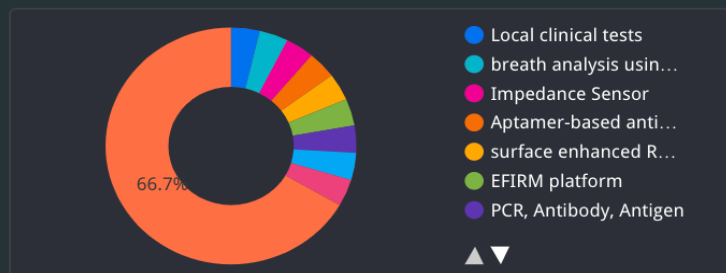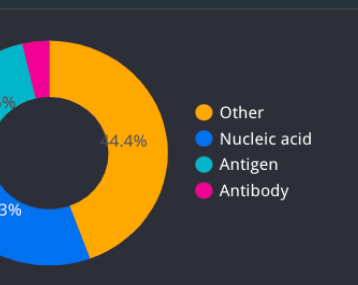Variants are hard to grow, and we don't really know what a variant is

- Use informatics approach to determine critical variants

- Develop a stable cell line producing low mutation high titer virus

- Use synthetic genes and CRISPR to produce variants

- Automate in a box

- Develop BioTechnicEthical Biohazard and safety board

1. Ethical risks

2. Health risks: expert and informatics assessed
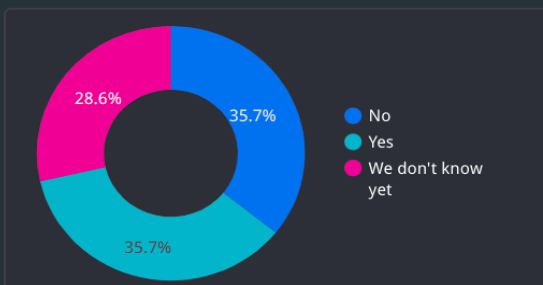
# Variants Strategy Timeline
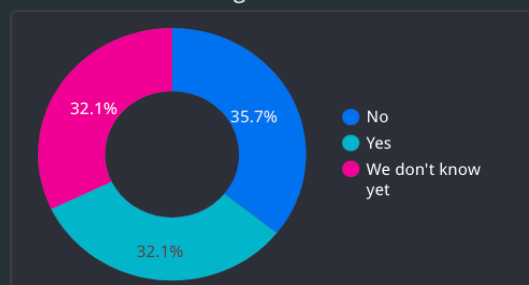
**5 March First biosafety meeting**

Establish criteria for safe variant production

**1 April Vector Production**

Begin work on stable cell line with low mutation rate and stable "parent virus

Definition of "variant" and variant target / acquisition strategy

**14 March**

CRISP Swaped genes to produce new Variant X.

**May 1 First Synthetic Variant**

# *Diagnostics* Needs: Preliminary results
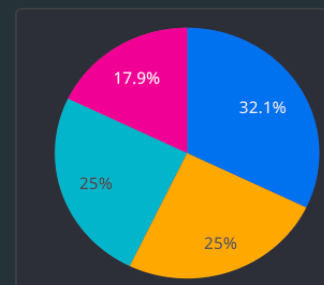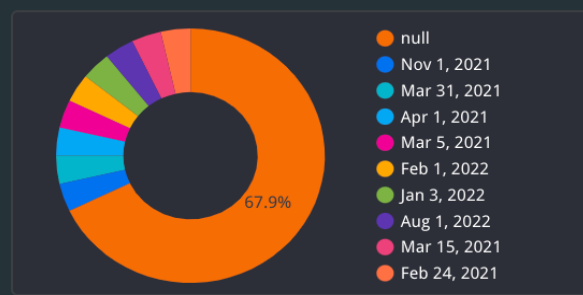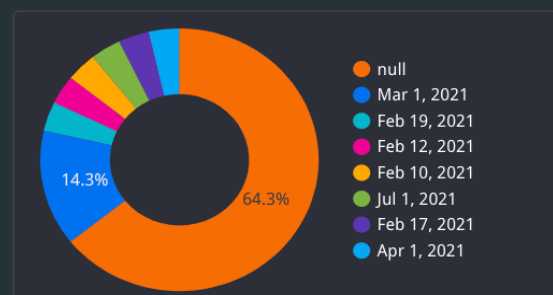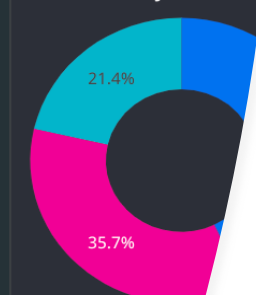
- More than a third to a half of awardees will likely need viral standards, some as early as spring, others starting in summer 2021

- Those who need standards require multiple forms or inactivation in a diverse set of contrived specimens

- The most common detection method is nucleic acid testing followed by antigen, antibodies and then non-traditional approaches such as VOCs, Enzymes or bioinformatic methods.

- About a third will need help with benchmarking, many aren't sure yet. Those with standard diagnostics will mostly report LOD and TAT.

- About a third will need help with usability, many aren't sure yet.

- There are a diversity of data storage and sharing types and some opportunities for LIMS use

# We will help awardees be successful

## ①

**Peace of mind for diagnostic development, data quality, hosting and distribution**

**Resources & Support**

**Training for team success**

# THANK YOU!

## Questions? Comments?

To the NIH, and RADx-rad awardees