Welcome to the Sentinel Innovation and Methods Seminar Series

The webinar will begin momentarily

- Please visit www.sentinelinitiative.org for recordings of past sessions and details on upcoming webinars.

- Note: closed-captioning for today's webinar will be available on the recording posted at the link above.
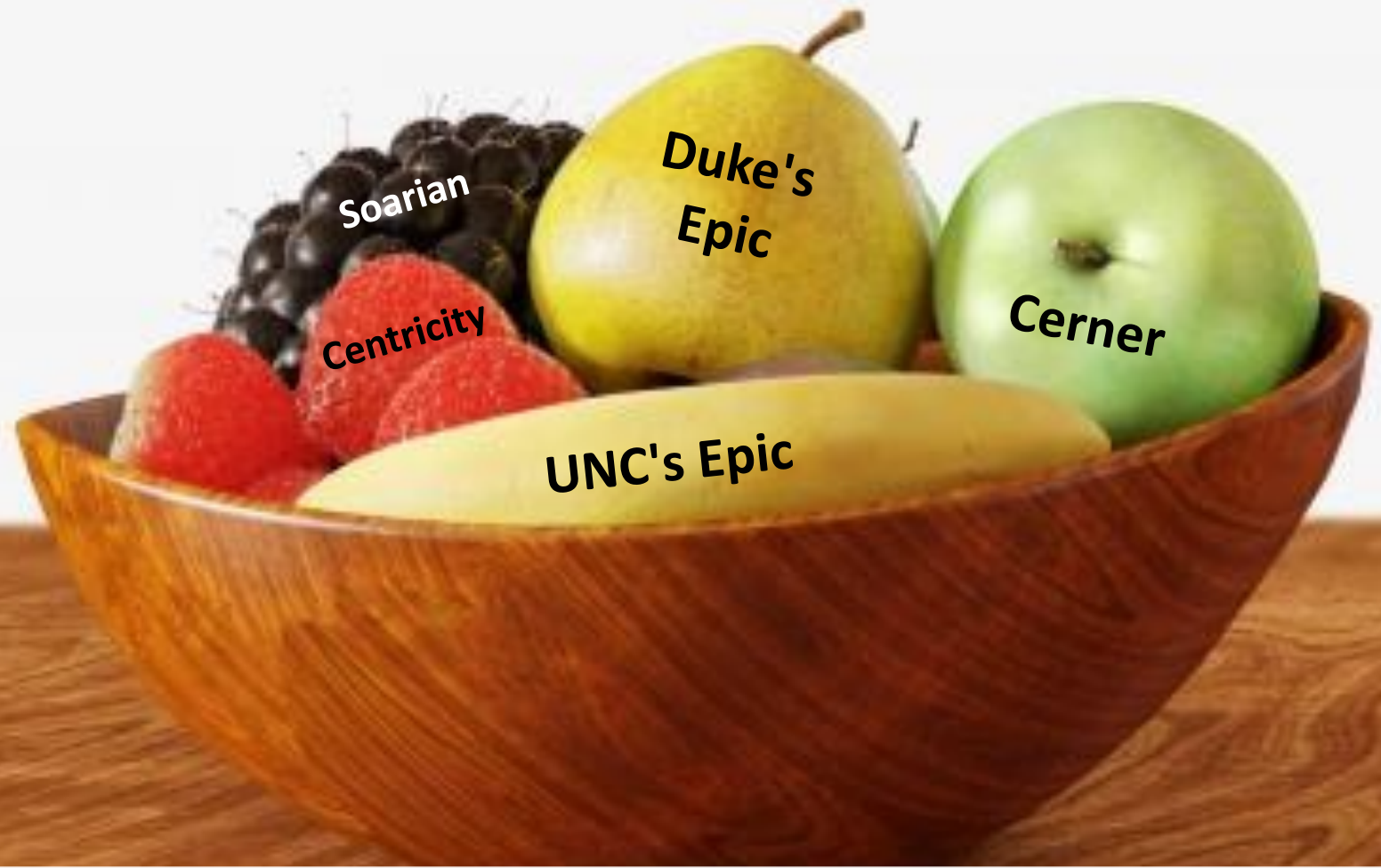
Sentinel

Do All Roads Lead to FHIR?

Imagining FHIR as a Meta-Common Data Model

Emily Pfaff, PhD, MS

THE UNIVERSITY *of* NORTH CAROLINA *at* CHAPEL HILL

EHR data across sites is similar… but not the same.

Both of these patients have COVID...

Hospital A

PATIENT_ID	DIAGNOSIS_ID	DIAGNOSIS_DATE
12345	1119302008	6/1/2020

Hospital B

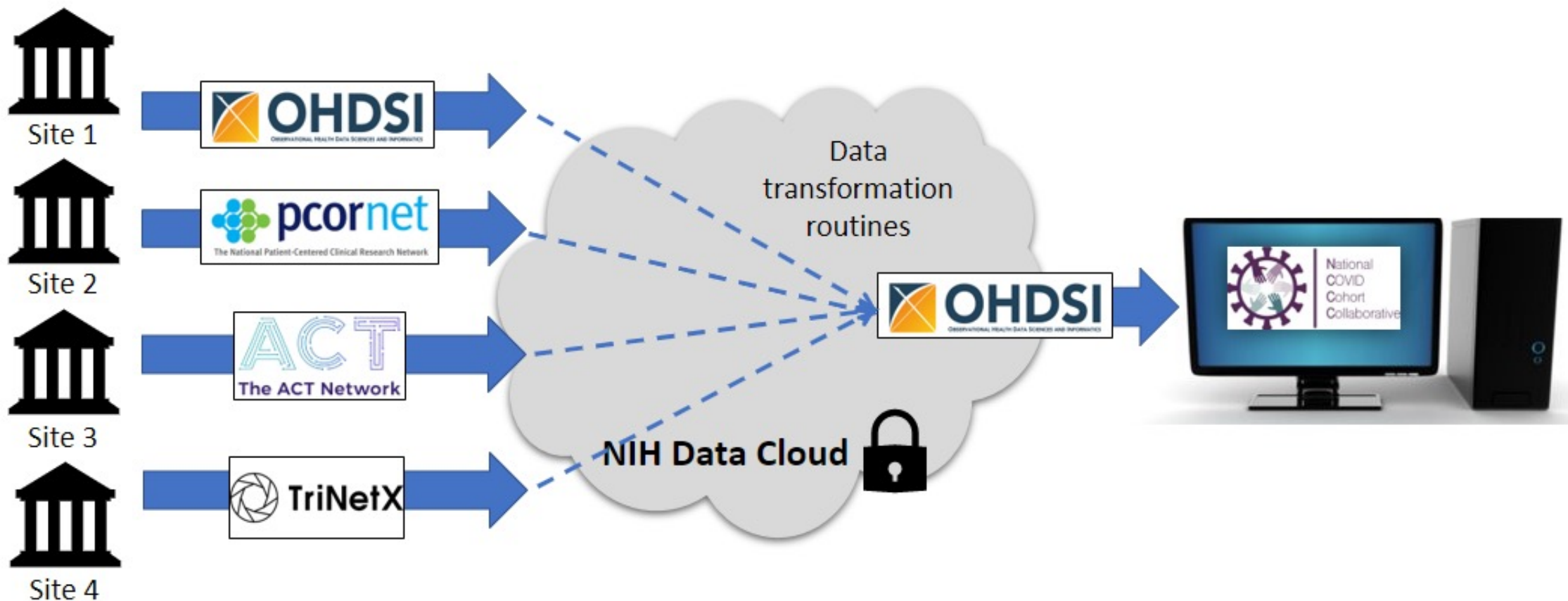| PATID	DIAGNOSIS_CD	DX_DT
12345	U07.1	2020-07-04

...But you can't use a single query to find them.

Common Data Models

- Found commonly at academic health centers.
- Enable EHR data sharing and standardization.
- "Curated" version of EHR data.
- Used mostly for research; not real-time.
- Not interoperable with each other (with exceptions, e.g. N3C).
- Generally costly to implement and maintain.

The CDMs *Can* Be Harmonized... With Massive Effort

Enter HL7 FHIR

- Standard healthcare data exchange format.

- Release 1 published in 2014; currently using R4.

- CMS is taking steps to require use of FHIR by both health care systems and payers to exchange data.

- FHIR capabilities are baked into modern EHR software.

Op Ed: Talking about FHIR is hard.

- App companies love FHIR.

- Software developers love FHIR.

- Interoperability advocates love FHIR.

For many of us, FHIR is a little hard to grasp. (Ever had someone try to explain the blockchain to you?)

Same information, encoded differently.

```
{
  "resourceType": "Bundle",
  "entry": [
    {
      "fullUrl": "https://www.hl7.org/fhir/patient.html",
      "resource": {
        "resourceType": "Patient",
        "id": "5433176",
        "extension": [
          {
            "url": "http://hl7.org/fhir/v3/Race",
            "valueString": "2106-3"
          }
        ],
        "gender": "female",
        "birthDate": "1954-04-11"
      }
    }
  }
  ...
```

PNT_ID	PNT_GENDER	PNT_BIRTHDATE	PNT_RACE	PNT_ETHNICITY
5433176	female	4/11/1954	2106-3	(null)

Data Exchange in Practice

1 Hospital A just admitted Erica Smith, who normally gets her care at Hospital B.

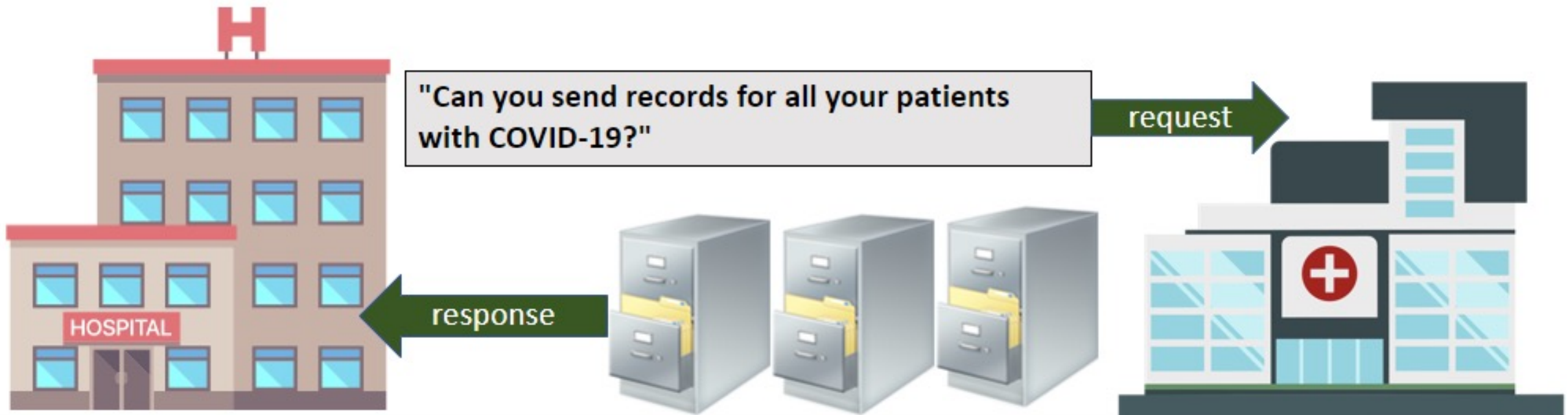**2** Hospital A can electronically request Erica's records from Hospital B.

request

3 Hospital B can send Erica's records in FHIR format.

response

Data Exchange in Practice

1 Hospital A just admitted Erica Smith, who normally gets her care at Hospital B.

2 Hospital A can electronically request Erica's records from Hospital B.

request

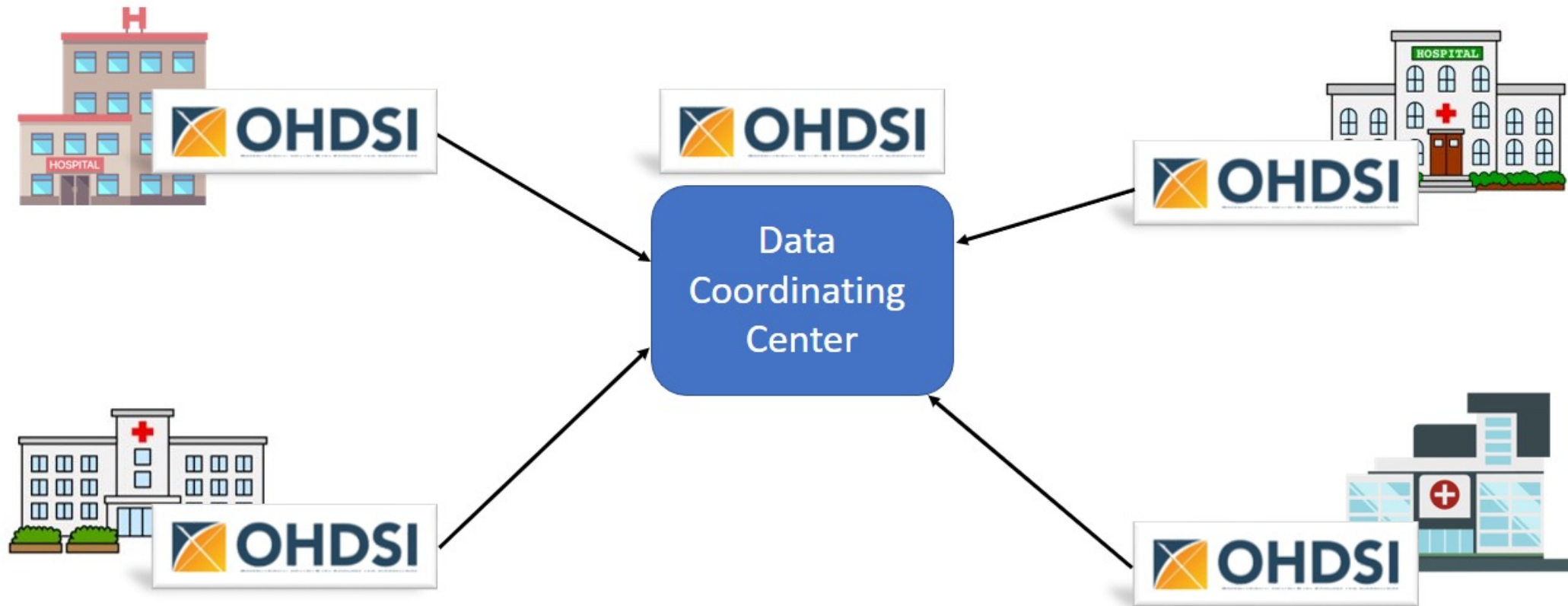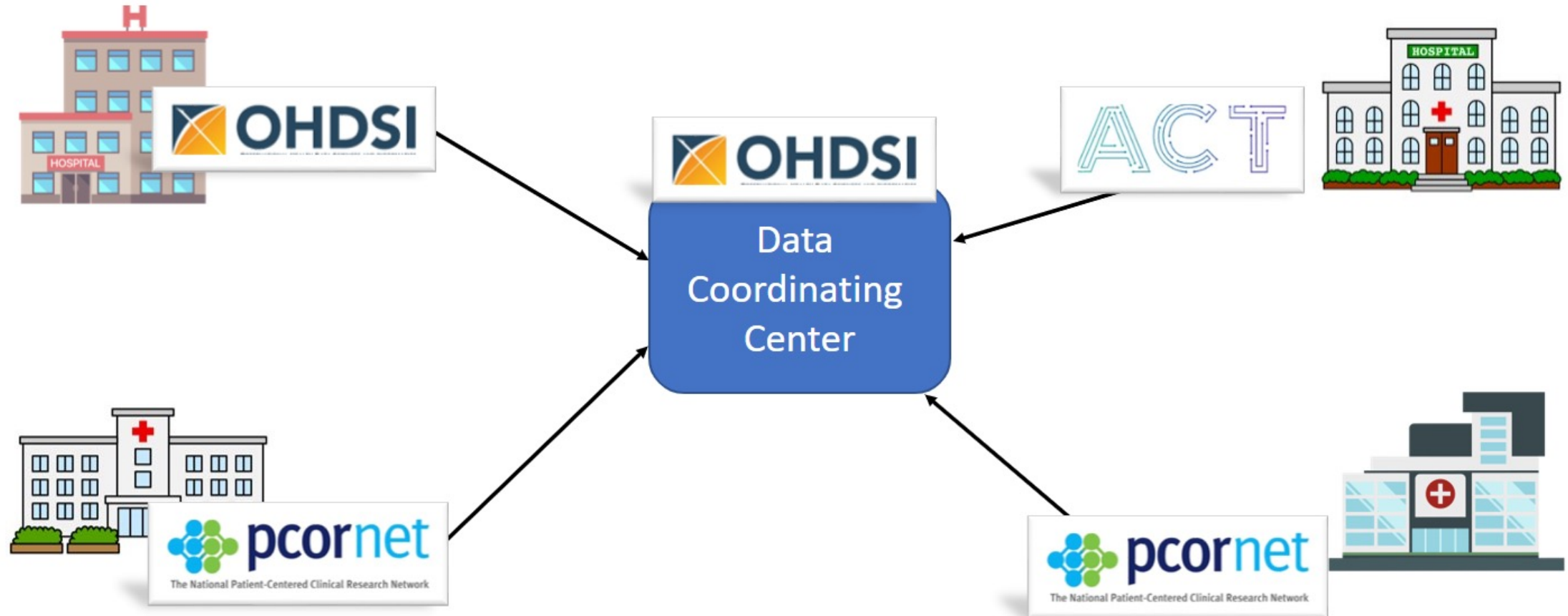**3** Hospital B can send Erica's records in FHIR format.

Erica Smith

- Bulk FHIR is needed for most research/population health purposes.
- This functionality (bulk FHIR API) is not consistently available today, but is coming.
- Nice overview of the current state of bulk FHIR: Mandl, et al (2020)
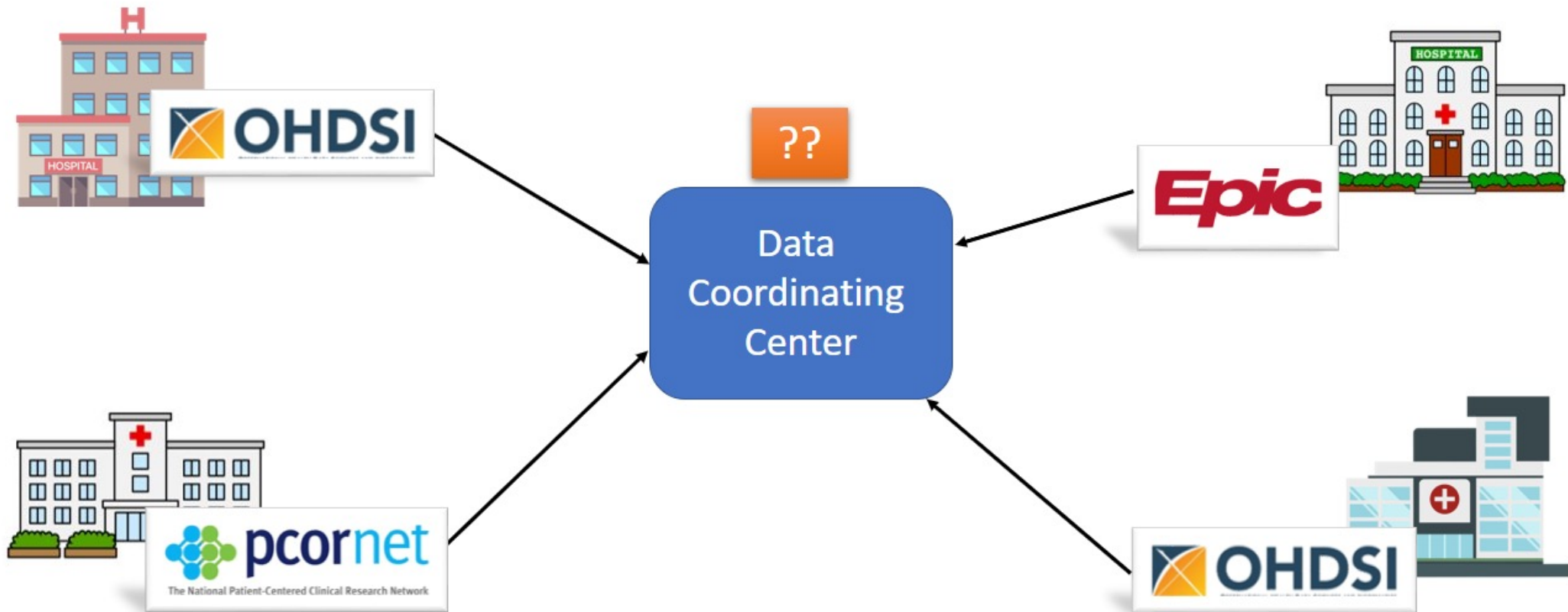- So, what do we do in the meantime?

FHIR For Multi-Site Research?

Scenario: All academic health centers, all have the same data model, DCC agrees on data model.
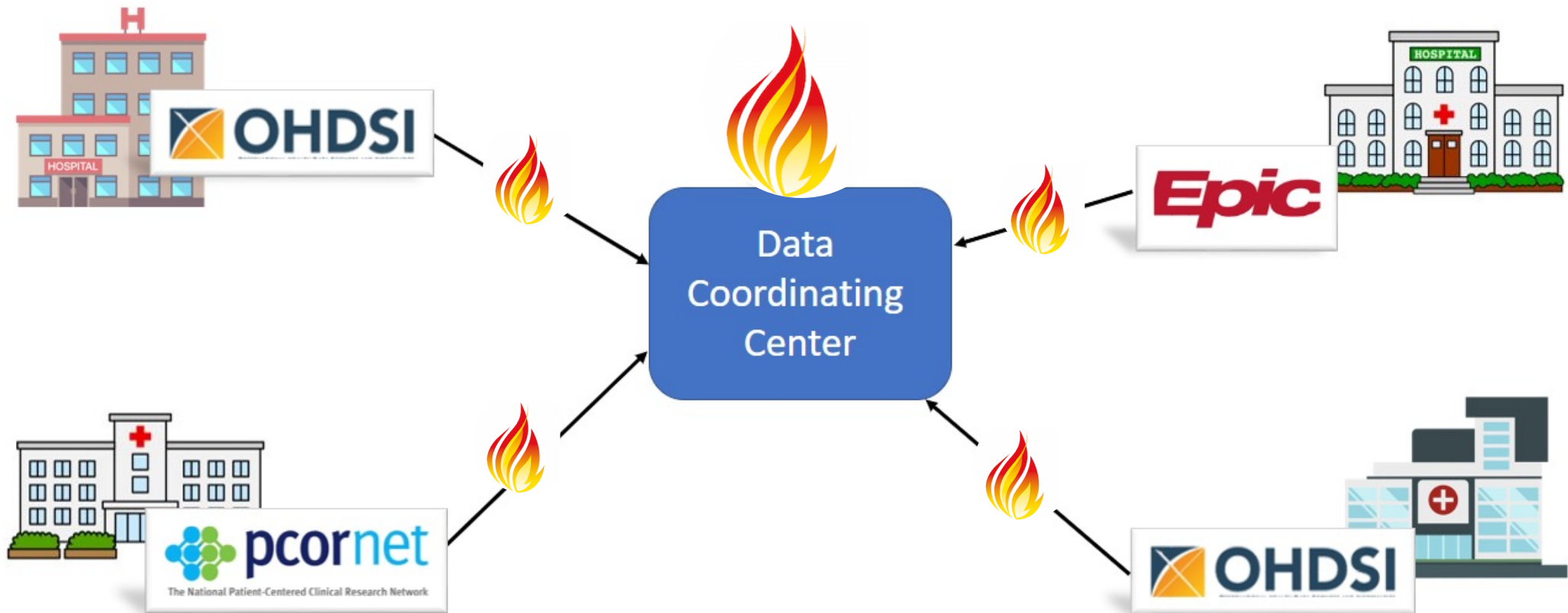
FHIR For Multi-Site Research?

Scenario: All academic health centers, mix of CDMs, DCC chooses to harmonize to one. Transformation can happen at each site, or centrally (a la N3C).
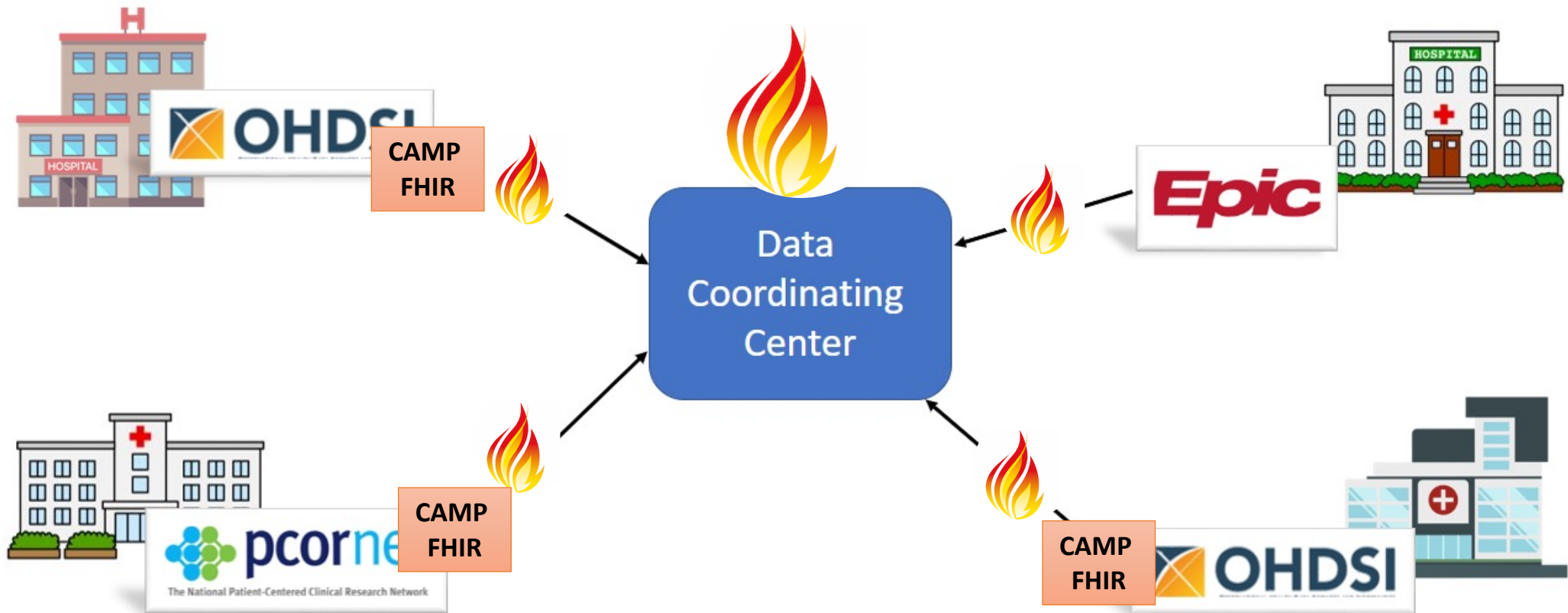
FHIR For Multi-Site Research?

Scenario: Mix of academic and non-academic health centers, mis-matched data models, one site has no CDM.
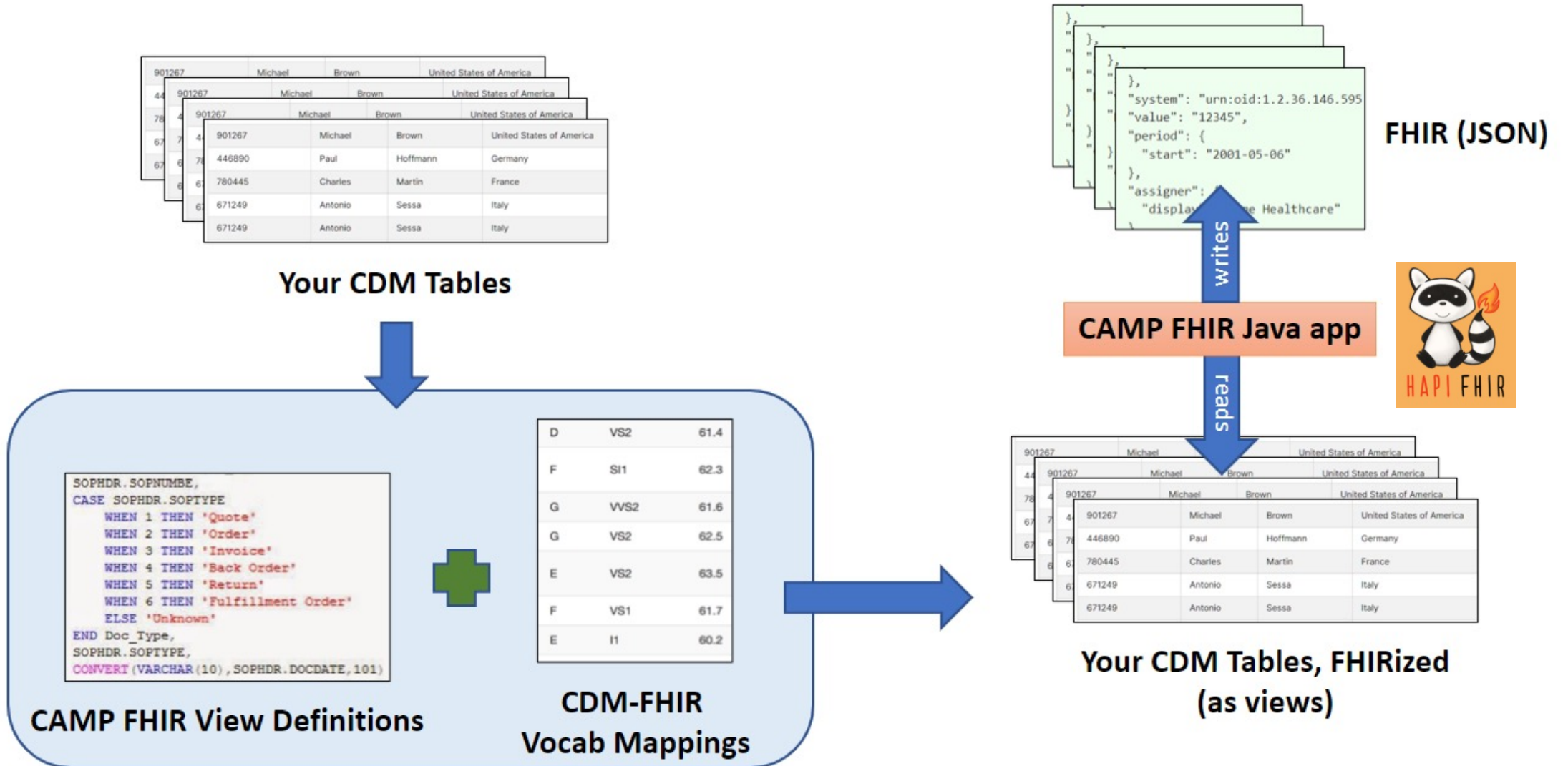
FHIR For Multi-Site Research?

Scenario: Mix of academic and non-academic health centers, mis-matched data models, one site has no CDM.

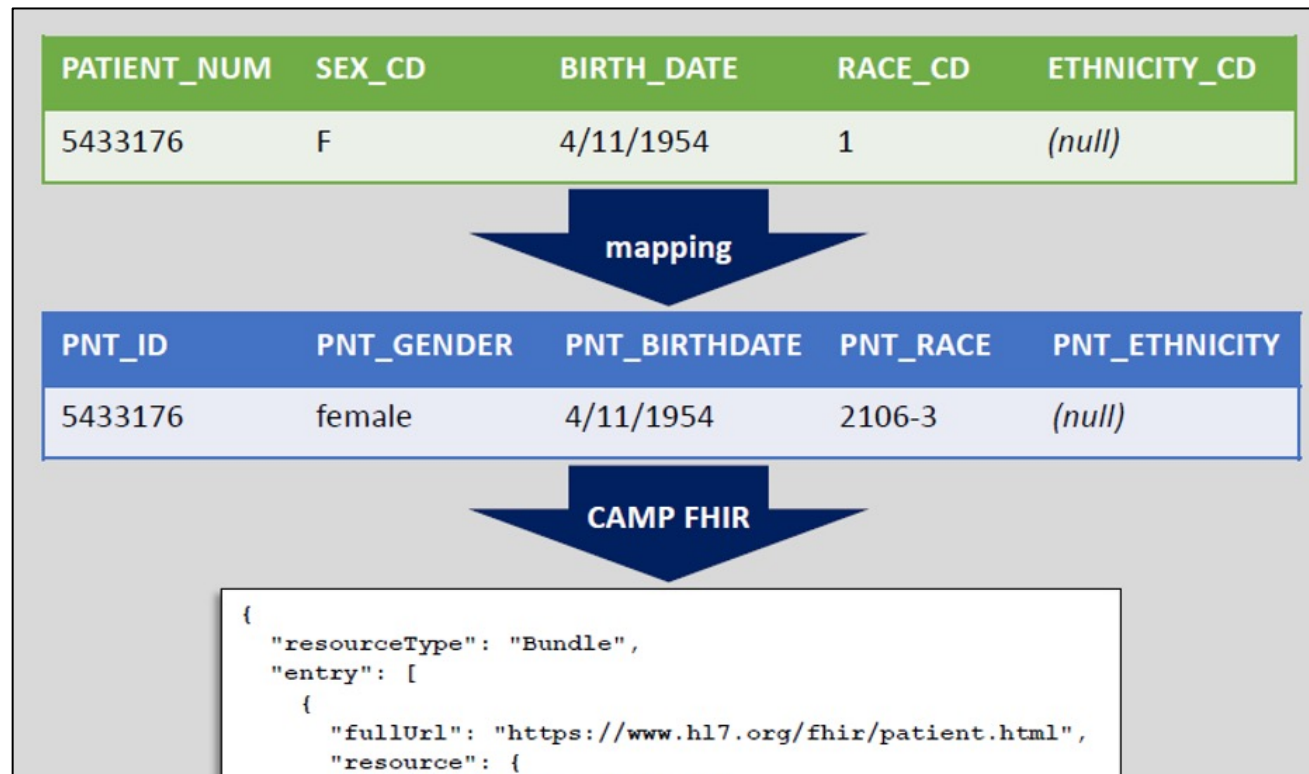# FHIR For Multi-Site Research?

Scenario: Mix of academic and non-academic health centers, mis-matched data models, one site has no CDM.

CAMP FHIR Data Flow

Mappings: The Heart of CAMP FHIR

PATIENT_NUM	SEX_CD	BIRTH_DATE	RACE_CD	ETHNICITY_CD
5433176	F	4/11/1954	1	(null)

mapping

PNT_ID	PNT_GENDER	PNT_BIRTHDATE	PNT_RACE	PNT_ETHNICITY
5433176	female	4/11/1954	2106-3	(null)

CAMP FHIR

```
{
    "resourceType": "Bundle",
    "entry": [
        {
            "fullUrl": "https://www.hl7.org/fhir/patient.html",
            "resource": {
```

- CAMP FHIR has no problem transforming data. Transforming it *correctly* requires mappings.

- **Variable or Field mappings,** e.g., PT_RACE in database 1 = PATIENT_RC in database 2.

- **Value set mappings,** e.g., "Pacific Islander" is coded as "PI" in database 1, and "37" in database 2.

Mappings: The Heart of CAMP FHIR

TABLE_CD	COLUMN_CD	LOCAL_IN_CD	FHIR_OUT_CD	FHIR_OUT_CHAR	FHIR_OUT_COLUMN
DEMOGRAPHIC	SEX	M	male	Male	PNT_GENDER
DEMOGRAPHIC	SEX	F	female	Female	PNT_GENDER
DEMOGRAPHIC	SEX	UN	unknown	Unknown	PNT_GENDER
DEMOGRAPHIC	SEX	A	other	Other	PNT_GENDER
DEMOGRAPHIC	SEX	NI	unknown	Unknown	PNT_GENDER
DEMOGRAPHIC	SEX	OT	other	Other	PNT_GENDER
DEMOGRAPHIC	RACE	01	1002-5	American Indian or Alaska Native	PNT_RACE
DEMOGRAPHIC	RACE	02	2028-9	Asian	PNT_RACE
DEMOGRAPHIC	RACE	03	2054-5	Black or African American	PNT_RACE
DEMOGRAPHIC	RACE	04	2076-8	Native Hawaiian or Other Pacific Islander	PNT_RACE
DEMOGRAPHIC	RACE	05	2106-3	White	PNT_RACE
DEMOGRAPHIC	RACE	06	2131-1	Other	PNT_RACE
DEMOGRAPHIC	RACE	07			PNT_RACE
DEMOGRAPHIC	RACE	NI			PNT_RACE
DEMOGRAPHIC	RACE	UN			PNT_RACE
DEMOGRAPHIC	RACE	OT	2131-1	Other	PNT_RACE
DEMOGRAPHIC	HISPANIC	Y	2135-2	Hispanic or Latino	PNT_ETHNICITY
DEMOGRAPHIC	HISPANIC	N	2186-5	Not Hispanic or Latino	PNT_ETHNICITY
DEMOGRAPHIC	HISPANIC	R			PNT_ETHNICITY
DEMOGRAPHIC	HISPANIC	NI			PNT_ETHNICITY
DEMOGRAPHIC	HISPANIC	UN			PNT_ETHNICITY
DEMOGRAPHIC	HISPANIC	OT			PNT_ETHNICITY

- In CAMP FHIR, value set mappings are in a table like the one shown here.

- This enables users to validate/change mappings without getting into the source code.

- Also makes updates easier—but mapping is a largely manual process.
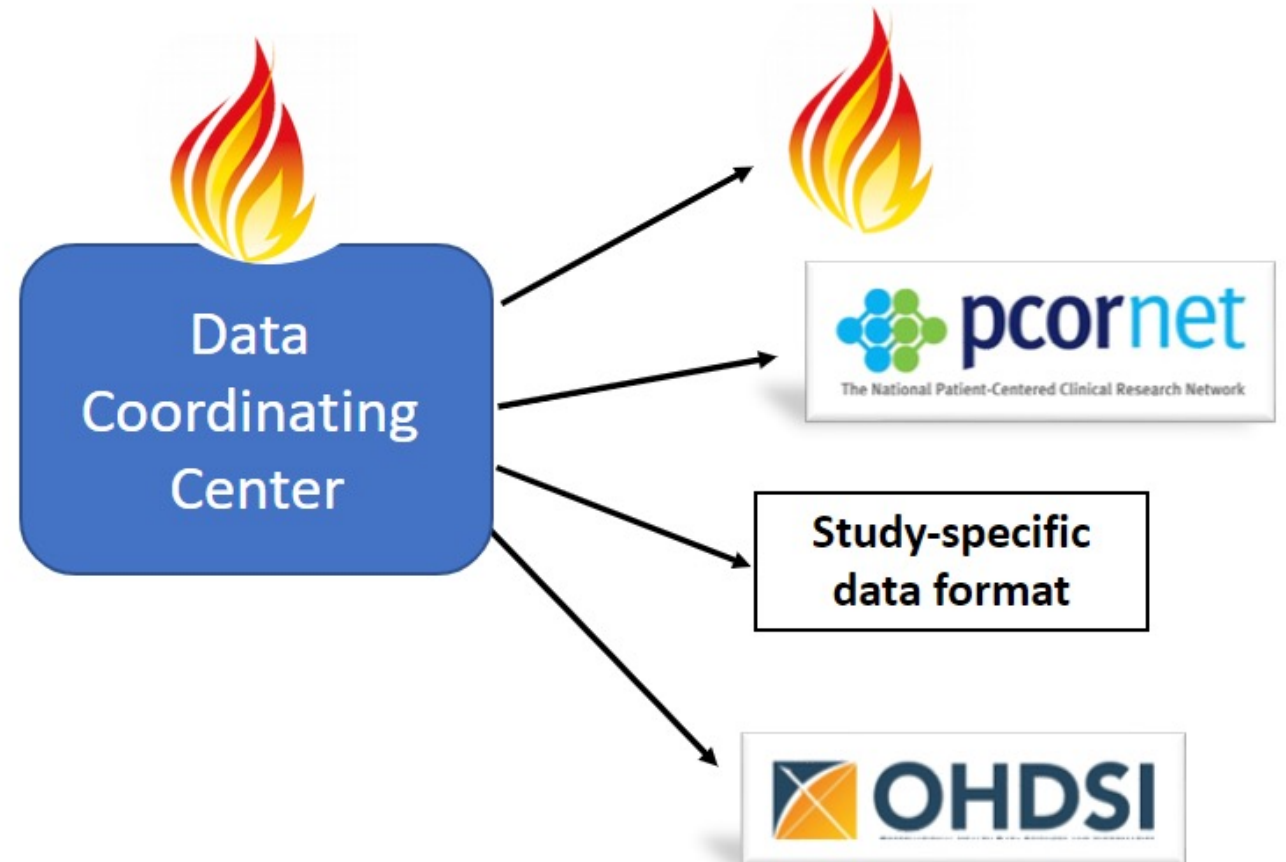
Using CAMP FHIR

Using CAMP FHIR

```
[james@UNC-MAC-JAMES Patient % ls -la
total 0
drwxr-xr-x  11 james   wheel   352 Feb 23 20:38 .
drwxrwxrwx  17 root    wheel   544 Feb 23 19:40 ..
-rw-r--r--   1 james   wheel     0 Feb 23 20:37 1000.json
-rw-r--r--   1 james   wheel     0 Feb 23 20:37 2000.json
-rw-r--r--   1 james   wheel     0 Feb 23 20:37 3000.json
-rw-r--r--   1 james   wheel     0 Feb 23 20:37 4000.json
-rw-r--r--   1 james   wheel     0 Feb 23 20:37 5000.json
-rw-r--r--   1 james
-rw-r--r--   1 james
-rw-r--r--   1 james
-rw-r--r--   1 james
james@UNC-MAC-JAMES
```

```
"resourceType": "Patient",
"id": "pat1",
"text": {
  "status": "generated",
  "div": "<div xmlns=\"http://www.w3.org/1999/xhtml\">\n        \n        <p>Patient Donald
},
"identifier": [
  {
    "use": "usual",
    "type": {
      "coding": [
        {
          "system": "http://terminology.hl7.org/CodeSystem/v2-0203",
          "code": "MR"
        }
      ]
    },
    "system": "urn:oid:0.1.2.3.4.5.6.7",
    "value": "654321"
  }
],
"active": true,
"name": [
  {
    "use": "official",
    "family": "Donald",
    "given": [
      "Duck"
    ]
  }
],
"gender": "male",
"photo": [
  {
    "contentType": "image/gif",
    "data": "R0lGOD1hEwARAPcAAAAAAAAA/+9aAO+1AP/WAP/eAP/eCP/eEP/eGP/nAP/nCP/nEP/nIf/nKf/
```

Working with FHIR Data

- Once data are in FHIR, you can:
  - Leave it in FHIR
  - Convert back to relational data
  - Convert back to a CDM
- Important consideration: FHIR data are large in size.
- Chosen path depends on use case.
- Bidirectional capability coming to CAMP FHIR in ~6 months.

Challenges/Caveats

CAMP FHIR

- Mappings are done by humans
- Mappings require maintenance/continued funding
- If a desired data element isn't in the CDM, it's less straightforward to use CAMP FHIR

FHIR

- File sizes can be large; cohorts more manageable than "everyone in the EHR"
- Current EHR/health care organization support for FHIR is mixed.

Workforce Development

- The relational database model has been around since 1969.

- The clinical informatics workforce is highly skilled in using relational data.

- Getting used to working with FHIR will require new skills, training, and time.

- If sites aren't comfortable with the technology, the barrier to use is high.

CAMP FHIR's Current State, Future Roadmap

- **Current state**
  - Support PCORnet (patient, prescribing, procedure, labs, vitals, diagnosis/condition, encounters)
  - Support ACT (but mappings need a round of updates for new ontology)
  - One direction (CDM to FHIR)
  - [Go get it here!](#)

- **Next Major Version Release (2.0, ~March 1)**
  - More fields mapped in PCORnet tables above
  - Basic GUI to replace/enhance command line
  - Major refactor to enable more FHIR resources

- **6 months**
  - Support more PCORnet tables
  - Add support for OMOP (but would love crowdsourced help with mappings beyond those in OMOPonFHIR)
  - Bidirectional (CDM FHIR, FHIR CDM)

- **1 year**
  - Mapping GUI

Takeaways

- FHIR is not ubiquitous yet, but it's getting there.
- Leveraging FHIR for research may enable a broader set of institutions to participate.
- CAMP FHIR enables institutions that already have a CDM to leverage that infrastructure to create FHIR on the fly.

Thank you !