

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.



Introduction to FHIR and Applications for Data Capture and Interoperability in Sentinel

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Sentinel Innovation and Methods Seminar

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Roadmap

- What is FHIR?
- What we've done
 - EHR -> REDCap
 - EHR -> ResearchMatch
 - REDCap -> FHIR Server
- What Sentinel could do

History of HL7 FHIR

- 2011 Graham Grieve of HL7 conceives of “Resources for Healthcare”
- 2013 SMART joins FHIR
- 2016 21st Century Cures Act passed
- 2020 CMS Interoperability and Patient Access final rule
- 2021 ONC Cures Act Final rule

FHIR Resources

Foundation	<p>Conformance</p> <ul style="list-style-type: none"> CapabilityStatement N StructureDefinition N ImplementationGuide 1 SearchParameter 3 MessageDefinition 1 OperationDefinition N CompartmentDefinition 1 StructureMap 2 GraphDefinition 1 ExampleScenario 0 	<p>Terminology</p> <ul style="list-style-type: none"> CodeSystem N ValueSet N ConceptMap 3 NamingSystem 1 TerminologyCapabilities 0 	<p>Security</p> <ul style="list-style-type: none"> Provenance 3 AuditEvent 3 Consent 2 	<p>Documents</p> <ul style="list-style-type: none"> Composition 2 DocumentManifest 2 DocumentReference 3 CatalogEntry 0 	<p>Other</p> <ul style="list-style-type: none"> Basic 1 Binary N Bundle N Linkage 0 MessageHeader 4 OperationOutcome N Parameters N Subscription 3
	<p>Individuals</p> <ul style="list-style-type: none"> Patient N Practitioner 3 PractitionerRole 2 RelatedPerson 2 Person 2 Group 1 	<p>Entities #1</p> <ul style="list-style-type: none"> Organization 3 OrganizationAffiliation 0 HealthcareService 2 Endpoint 2 Location 3 	<p>Entities #2</p> <ul style="list-style-type: none"> Substance 2 BiologicallyDerivedProduct 0 Device 2 DeviceMetric 1 	<p>Workflow</p> <ul style="list-style-type: none"> Task 2 Appointment 3 AppointmentResponse 3 Schedule 3 Slot 3 VerificationResult 0 	<p>Management</p> <ul style="list-style-type: none"> Encounter 2 EpisodeOfCare 2 Flag 1 List 1 Library 2
	<p>Summary</p> <ul style="list-style-type: none"> AllergyIntolerance 3 AdverseEvent 0 Condition (Problem) 3 Procedure 3 FamilyMemberHistory 2 ClinicalImpression 0 DetectedIssue 1 	<p>Diagnostics</p> <ul style="list-style-type: none"> Observation N Media 1 DiagnosticReport 3 Specimen 2 BodyStructure 1 ImagingStudy 3 QuestionnaireResponse 3 MolecularSequence 1 	<p>Medications</p> <ul style="list-style-type: none"> MedicationRequest 3 MedicationAdministration 2 MedicationDispense 2 MedicationStatement 3 Medication 3 MedicationKnowledge 0 Immunization 3 ImmunizationEvaluation 0 ImmunizationRecommendation 1 	<p>Care Provision</p> <ul style="list-style-type: none"> CarePlan 2 CareTeam 2 Goal 2 ServiceRequest 2 NutritionOrder 2 VisionPrescription 2 RiskAssessment 1 RequestGroup 2 	<p>Request & Response</p> <ul style="list-style-type: none"> Communication 2 CommunicationRequest 2 DeviceRequest 1 DeviceUseStatement 0 GuidanceResponse 2 SupplyRequest 1 SupplyDelivery 1
	<p>Support</p> <ul style="list-style-type: none"> Coverage 2 CoverageEligibilityRequest 2 CoverageEligibilityResponse 2 EnrollmentRequest 0 EnrollmentResponse 0 	<p>Billing</p> <ul style="list-style-type: none"> Claim 2 ClaimResponse 2 Invoice 0 	<p>Payment</p> <ul style="list-style-type: none"> PaymentNotice 2 PaymentReconciliation 2 	<p>General</p> <ul style="list-style-type: none"> Account 2 ChargeItem 0 ChargeItemDefinition 0 Contract 1 ExplanationOfBenefit 2 InsurancePlan 0 	
Financial					

MedicationRequest

Structure

Name	Flags	Card.	Type	Description & Constraints
MedicationRequest	TU		DomainResource	Ordering of medication for patient or group Elements defined in Ancestors: id, meta, implicitRules, language, text, contained, extension, modifierExtension
identifier		0..*	Identifier	External ids for this request
status	?!	Σ 1..1	code	active on-hold cancelled completed entered-in-error stopped draft unknown Medicationrequest status (Required)
statusReason		0..1	CodeableConcept	Reason for current status Medication request status reason codes (Example)
intent	?!	Σ 1..1	code	proposal plan order original-order reflex-order filler-order instance-order option Medication request intent (Required)
category		0..*	CodeableConcept	Type of medication usage Medication request category codes (Example)
priority		Σ 0..1	code	routine urgent asap stat Request priority (Required)
doNotPerform	?!	Σ 0..1	boolean	True if request is prohibiting action
reported[x]		Σ 0..1		Reported rather than primary record
reportedBoolean			boolean	
reportedReference			Reference(Patient Practitioner PractitionerRole RelatedPerson Organization)	
medication[x]		Σ 1..1		Medication to be taken SNOMED CT Medication Codes (Example)
medicationCodeableConcept			CodeableConcept	
medicationReference			Reference(Medication)	
subject		Σ 1..1	Reference(Patient Group)	Who or group medication request is for
encounter		0..1	Reference(Encounter)	Encounter created as part of encounter/admission/stay
supportingInformation		0..*	Reference(Any)	Information to support ordering of the medication
authoredOn		Σ 0..1	dateTime	When request was initially authored
requester		Σ 0..1	Reference(Practitioner PractitionerRole Organization Patient RelatedPerson Device)	Who/What requested the Request
performer		0..1	Reference(Practitioner PractitionerRole Organization Patient Device RelatedPerson CareTeam)	Intended performer of administration
performerType		Σ 0..1	CodeableConcept	Desired kind of performer of the medication administration Procedure Performer Role Codes (Example)
recorder		0..1	Reference(Practitioner PractitionerRole)	Person who entered the request
reasonCode		0..*	CodeableConcept	Reason or indication for ordering or not ordering the medication Condition/Problem/Diagnosis Codes (Example)
reasonReference		0..*	Reference(Condition Observation)	Condition or observation that supports why the prescription is being written
instantiatesCanonical		Σ 0..*	canonical()	Instantiates FHIR protocol or definition
instantiatesUri		Σ 0..*	uri	Instantiates external protocol or definition
basedOn		Σ 0..*	Reference(CarePlan MedicationRequest ServiceRequest ImmunizationRecommendation)	What request fulfills

```

<MedicationRequest xmlns="http://hl7.org/fhir">
  <!-- from Resource: id, meta, implicitRules, and language -->
  <!-- from DomainResource: text, contained, extension, and modifierExtension -->
  <identifier><!-- 0..* Identifier External ids for this request --></identifier>
  <status value="[code]"/><!-- 1..1 active | on-hold | cancelled | completed | entered-in-error |
  stopped | draft | unknown -->
  <statusReason><!-- 0..1 CodeableConcept Reason for current status --></statusReason>
  <intent value="[code]"/><!-- 1..1 proposal | plan | order | original-order | reflex-order | fil
  ler-order | instance-order | option -->
  <category><!-- 0..* CodeableConcept Type of medication usage --></category>
  <priority value="[code]"/><!-- 0..1 routine | urgent | asap | stat -->
  <doNotPerform value="[boolean]"/><!-- 0..1 True if request is prohibiting action -->
  <reported[x><!-- 0..1 boolean|Reference(Patient|Practitioner|PractitionerRole|
  RelatedPerson|Organization) Reported rather than primary record --></reported[x]>
  <medication[x]><!-- 1..1 CodeableConcept|Reference(Medication) Medication to be taken --></medi
  cation[x]>
  <subject><!-- 1..1 Reference(Patient|Group) Who or group medication request is for --></subject
  >
  <encounter><!-- 0..1 Reference(Encounter) Encounter created as part of encounter/admission/stay
  --></encounter>
  <supportingInformation><!-- 0..* Reference(Any) Information to support ordering of the medicati
  on --></supportingInformation>
  <authoredOn value="[dateTime]"/><!-- 0..1 When request was initially authored -->
  <requester><!-- 0..1 Reference(Practitioner|PractitionerRole|Organization|
  Patient|RelatedPerson|Device) Who/What requested the Request --></requester>
  <performer><!-- 0..1 Reference(Practitioner|PractitionerRole|Organization|
  Patient|Device|RelatedPerson|CareTeam) Intended performer of administration --></performer>
  <performerType><!-- 0..1 CodeableConcept Desired kind of performer of the medication administra
  tion --></performerType>
  <recorder><!-- 0..1 Reference(Practitioner|PractitionerRole) Person who entered the request -->
  </recorder>
  <reasonCode><!-- 0..* CodeableConcept Reason or indication for ordering or not ordering the med
  ication --></reasonCode>
  <reasonReference><!-- 0..* Reference(Condition|Observation) Condition or observation that suppo
  rts why the prescription is being written --></reasonReference>
  <instantiatesCanonical value="[canonical]"/><!-- 0..* Instantiates FHIR protocol or definition
  -->
  <instantiatesUri value="[uri]"/><!-- 0..* Instantiates external protocol or definition -->
  <basedOn><!-- 0..* Reference(CarePlan|MedicationRequest|ServiceRequest|
  ImmunizationRecommendation) What request fulfills --></basedOn>
  <groupIdentifier><!-- 0..1 Identifier Composite request this is part of --></groupIdentifier>
  <courseOfTherapyType><!-- 0..1 CodeableConcept Overall pattern of medication administration -->
  </courseOfTherapyType>
  <insurance><!-- 0..* Reference(Coverage|ClaimResponse) Associated insurance coverage --></insur
  ance>
  <note><!-- 0..* Annotation Information about the prescription --></note>
  <dosageInstruction><!-- 0..* Dosage How the medication should be taken --></dosageInstruction>
  <dispenseRequest><!-- 0..1 Medication supply authorization -->
  <initialFill><!-- 0..1 First fill details -->
  <quantity><!-- 0..1 Quantity(SimpleQuantity) First fill quantity --></quantity>
  <duration><!-- 0..1 Duration First fill duration --></duration>
  </initialFill>
  <dispenseInterval><!-- 0..1 Duration Minimum period of time between dispenses --></dispenseInt
  erval>
  <validityPeriod><!-- 0..1 Period Time period supply is authorized for --></validityPeriod>
  <numberOfRepeatsAllowed value="[unsignedInt]"/><!-- 0..1 Number of refills authorized -->
  <quantity><!-- 0..1 Quantity(SimpleQuantity) Amount of medication to supply per dispense --></
  
```

EHR FHIR APIs

- AdverseEvent**
Read, Search — R4
- AllergyIntolerance**
Read, Search, Create — R4
Read, Search, Create — STU3
Read, Search — DSTU2
- Appointment**
Read, \$book, \$find — STU3
- Binary (CCDA Documents)**
Read — DSTU2
- Binary (Clinical Notes)**
Read — R4
Read, Search — STU3
- Binary (Practitioner Photo)**
Read — R4
- CarePlan**
Read, Search — R4
Read, Search — DSTU2
- CarePlan (Dental CarePlan)**
Read, Search — R4
- CarePlan (Encounter Level Care Plan)**
Read, Search — R4
- CarePlan (Inpatient CarePlan)**
Read, Search — R4
- CarePlan (Longitudinal Care Plan)**
Read, Search — R4
- CarePlan (Outpatient CarePlan)**
Read, Search — R4
- CarePlan (Questionnaires Due)**
Read, Search — R4
- CareTeam**
Read, Search — R4
- Communication**
Read, Search, Create — R4
- Condition**
Read, Search, Create — STU3
Read, Search — DSTU2
Create — CDS Hooks - STU3
- Condition (Care Plan Problem)**
Read, Search — R4
- Condition (Encounter Diagnosis)**
Read, Search — R4
Create — CDS Hooks - R4
- Condition (Genomics)**
Read, Search — R4
- Condition (Health Concern)**
Read, Search — R4
- Condition (Problems)**
Read, Search, Create — R4
Create — CDS Hooks - R4
- Consent**
Read, Search — R4
- Coverage**
Read, Search — R4
Read, Search — STU3
- COVID SMART Scheduling Links**
\$bulk-publish — R4
- Device**
Read, Search — R4
Read, Search — STU3
Read, Search — DSTU2
- DiagnosticReport**
Read, Search — R4
Read, Search — STU3
Read, Search — DSTU2
- DocumentReference**
Read, Search — DSTU2
- DocumentReference (Clinical Notes)**
Read, Search, Create — R4
Read, Search, Create — STU3
- Encounter**
Read, Search — R4
Read, Search — STU3
- Endpoint**
Read — R4
Read — STU3
- ExplanationOfBenefit**
Read, Search — R4
- FamilyMemberHistory**
Search — DSTU2
- Goal**
Read, Read, Read, Search, Search, Search — R4
Read, Search, Create — STU3
Read, Search — DSTU2
- Immunization**
Read, Search — R4
Read, Search — STU3
Read, Search — DSTU2
- Immunization (LDA-W)**
Read, Search, Create, Update — R4
Read, Search, Create, Update — STU3
- Observation (Obstetric Details)**
Read, Search — R4
Read, Search — STU3
- Observation (Smoking History)**
Read, Search — R4
Read, Search — STU3
Read, Search — DSTU2
- Observation (Vitals)**
Read, Search, Create — R4
Read, Search, Create — STU3
Read, Search — DSTU2
- Organization**
Read, Search — R4
Read — STU3
- Patient**
Read, Search, Create — R4
Read, Search, Create — STU3
Read, Search — DSTU2
- Practitioner**
Read, Search — R4
Read, Search — STU3
Read, Search — DSTU2
- Medication**
Read — R4
Read — STU3
Read, Search — DSTU2
- MedicationRequest**
Read, Search — R4
- MedicationRequest (Unsigned Medication Order)**
Read — R4
Create — CDS Hooks - R4
Create — CDS Hooks - STU3
- MedicationRequest / MedicationOrder**
Read, Search — R4
Read, Search — STU3
Read, Search — DSTU2
- MedicationStatement**
Read, Search — STU3
Read, Search — DSTU2
- Observation (Core Characteristics)**
Read, Search — R4
Read, Search — STU3
- Observation (Labs)**
Read, Search — R4
Read, Search — STU3
Read, Search — DSTU2
- PractitionerRole**
Read, Search — R4
Read, Search — STU3
- Procedure**
Read, Search — R4
Read, Search — STU3
Read, Search — DSTU2
- Procedure (Surgery Procedure)**
Read, Search — R4
- Procedure (Surgical History)**
Read, Search — R4
- Questionnaire**
Read — R4
- Questionnaire (Appointment and Series Questionnaires)**
Read, Search, Search, Create — R4
- QuestionnaireResponse**
Read — R4
- RelatedPerson**
Read — R4
- RequestGroup (Dental Visit)**
Read, Search — R4
- ResearchStudy**
Read — R4
- Schedule**
Read — STU3
- ServiceRequest**
Read, Read, Search, Search — R4
- ServiceRequest (Dental Procedure)**
Read — R4
- ServiceRequest (Unsigned Procedure Order)**
Read — R4
Create — CDS Hooks - R4
Create — CDS Hooks - STU3
- ServiceRequest / ProcedureRequest**
Read, Search — R4
Read, Search — STU3
- Slot**
Read — STU3
- Specimen**
Read, Search — R4
- Task**
Read, Search, Update — R4
- ValueSet**
\$expand — R4

DSTU 2 Resource	Supported Actions	R4 Resource	Supported Actions
		Account	📄 🔍
AllergyIntolerance	📄 🔍 + ✎	AllergyIntolerance	📄 🔍 + ✎
Appointment	📄 🔍 + ✎	Appointment	📄 🔍 + 🗑️
		Basic	+
Binary	📄	Binary	📄
Conformance *	📄	CapabilityStatement *	📄
		CarePlan *	📄 🔍
		CareTeam *	📄 🔍
		ChargeItem	📄
		Communication	📄 🔍 + 🗑️
Condition	📄 🔍 + ✎	Condition	📄 🔍 + ✎
Contract *	📄 🔍	Consent *	📄 🔍
		Coverage	🔍 + 🗑️ 🗑️
Device	📄 🔍	Device	📄 🔍
DiagnosticReport	🔍		
DocumentReference	📄 🔍 +	DocumentReference	📄 🔍 + ✎
Encounter	📄 🔍	Encounter	📄 🔍 + 🗑️
		FinancialTransaction *	+
Goal	📄 🔍	Goal	📄 🔍
Immunization	📄 🔍	Immunization	📄 🔍 + ✎
		Location	📄 🔍
MedicationAdministration	📄 🔍		
MedicationOrder *	📄 🔍		
MedicationStatement *	📄 🔍 + ✎	MedicationRequest *	📄 🔍 + 🗑️
		NutritionOrder	📄 🔍
Observation	🔍	Observation	📄 🔍 + ✎
OperationDefinition	📄	OperationDefinition	📄
		Organization	📄 🔍 +
Patient	📄 🔍 +	Patient	📄 🔍 + 🗑️
Person	📄 🔍	Person	📄 🔍
Practitioner	📄 🔍	Practitioner	📄 🔍 +
Procedure	📄 🔍	Procedure	📄 🔍 +
		Provenance	📄 🔍 +
		Questionnaire	📄 🔍
		QuestionnaireResponse	📄 🔍 ✎
RelatedPerson	📄 🔍	RelatedPerson	📄 🔍 + 🗑️
Schedule	📄 🔍	Schedule	📄 🔍
ProcedureRequest *	📄 🔍	ServiceRequest *	📄 🔍
Slot	📄 🔍	Slot	📄 🔍 🗑️
StructureDefinition	📄	StructureDefinition	📄

MedicationRequest

MedicationRequest.Read (Order Template) (R4) Industry-Standard

MedicationRequest (MedicationRequest)

Name	Description	Is Optional	Is Array
authoredOn (String)	Order signing time.	true	false
category (CodeableConcept)	Order mode.	true	true
dosageInstruction (Dosage)	Dosage instruction details.	true	true
encounter (Reference)	Reference to the order template's linked encounter.	true	false
intent (String)	FHIR intent based on order status.	false	false
medicationReference (Reference)	Reference to another resource.	false	false
note (Annotation)	Order comments.	true	true
requester (Reference)	Reference to order signing user	true	false
status (String)	Order status.	false	false
subject (Reference)	The patient or subject.	true	false

dosageInstruction (Dosage)

Name	Description	Is Optional	Is Array
timing (Timing)	Dosage timing instructions.	true	false

timing (Timing)

Name	Description	Is Optional	Is Array
repeat (Repeat)	Repeat occurrence information.	true	false

repeat (Repeat)

Name	Description	Is Optional	Is Array
boundsPeriod (Period)	Duration information.	true	false
count (Int64)	Number of treatments.	true	false
dayOfWeek (String)	Interval days.	true	false
period (Decimal)	Interval period.	true	false
periodUnit (String)	Interval period unit.	true	false

```
<MedicationRequest xmlns="http://hl7.org/fhir">
  <id value="euHtu0fIBKsu8UhaYJawMfg3" />
  <status value="draft" />
  <intent value="proposal" />
  <category>
    <coding>
      <system value="http://terminology.hl7.org/CodeSystem/medicationrequest-category" />
      <code value="Inpatient" />
      <display value="Inpatient" />
    </coding>
    <text value="Inpatient" />
  </category>
  <medicationReference>
    <reference value="Medication/euHtu0fIBKsu8UhaYJawMfg3" />
    <display value="lorazepam (ATIVAN) injection 0.5 mg" />
  </medicationReference>
  <subject>
    <reference value="Patient/eFV66xzT5B1w5K9vVA9Pgag3" />
    <display value="Name, Patient" />
  </subject>
  <dosageInstruction>
    <timing>
      <code>
        <text value="Every visit" />
      </code>
    </timing>
  </dosageInstruction>
</MedicationRequest>
```

SMART on FHIR Apps



Featured Apps

Sort: Name (A-Z) ▾

Featured Apps

All Apps

Care Coordination

Clinical Research

Data Visualization

Disease Management

Genomics

Medication

Patient Engagement

Population Health

Risk Calculation



Arrest Assist - Reversible Causes of PEA Arrest Tool

[View](#)

MedStar Institute for Innovation (MI2)

A tool that searches a patient's medical history for reversible causes of PEA arrest. Great for hospital based code teams.

Specialties: Cardiology, Pulmonary, Anesthesiology **Designed for:** Clinicians



ASCVD Risk Calculator

[View](#)

Cerner Corporation

The ASCVD Risk Calculator is a tool that estimates a 10-year and/or lifetime cardiovascular risk score and how to potentially reduce risk.

Support: Web **Specialties:** Cardiology **Designed for:** Clinicians & Patients



Atrial Fibrillation Stroke Risk - CHA2DS2-VASc Score

[View](#)

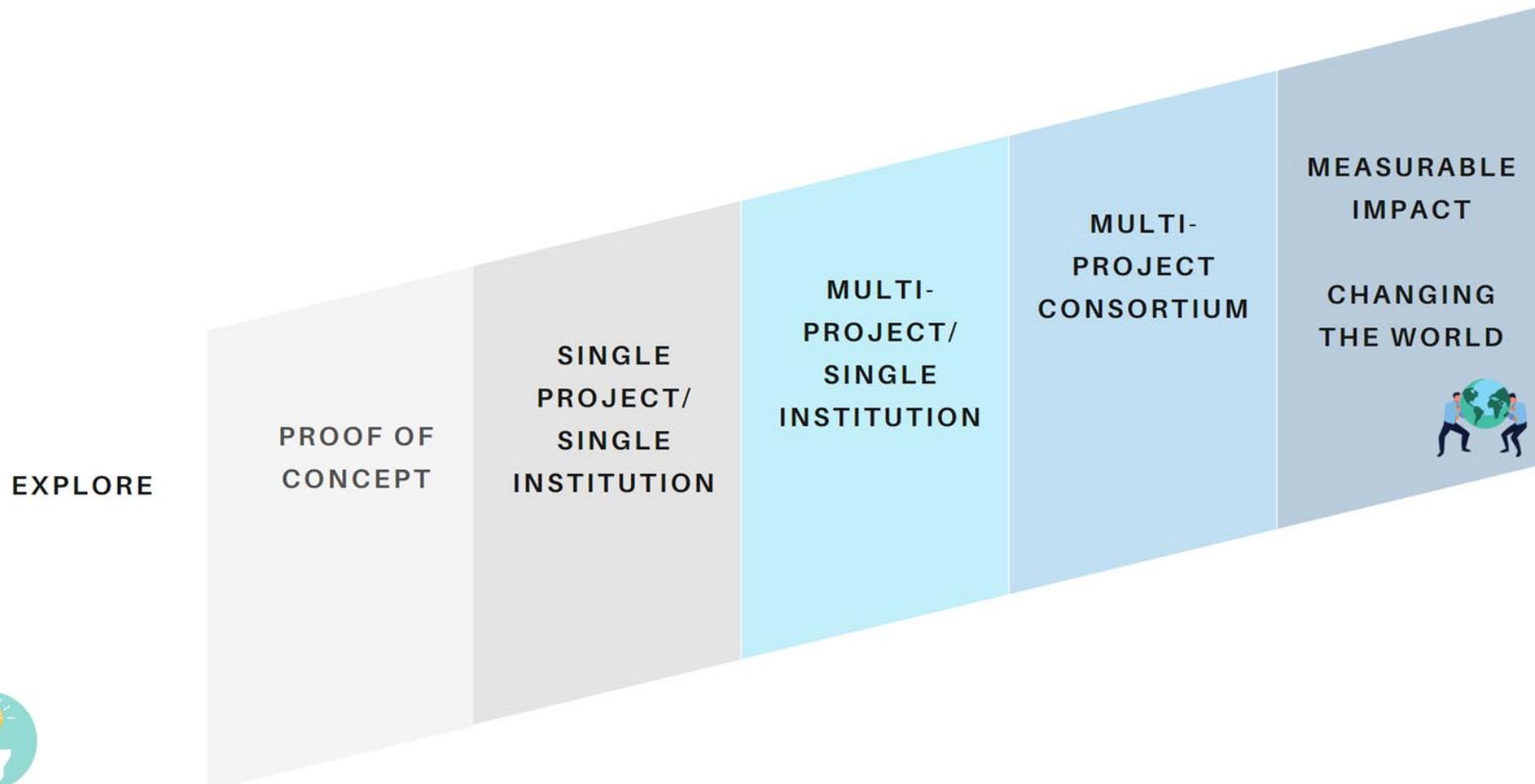
MedStar Institute for Innovation (MI2)



What we've done

- EHR -> REDCap^{xx}
- EHR -> ResearchMatch
- REDCap -> FHIR Server

Framing Our Work: Real-World Impact



EHR -> REDCap

The screenshot displays the REDCap website interface. At the top left is the REDCap logo with the tagline "Research Electronic Data Capture". To the right of the logo are five statistics in red-bordered boxes: Institutions (5099), Countries (141), Projects (1.2M), Users (1.8M), and Articles (13.9k). Further right is a navigation menu with links for ABOUT, PARTNERS, RESOURCES, and SOFTWARE.

Below the statistics is a red text link: [How REDCap is being used in response to COVID-19](#)

The main content area features a world map with numerous red location pins indicating global usage. The map includes a "Map" and "Satellite" toggle, a full-screen icon, and zoom controls (+ and -). The Google logo is visible in the bottom left corner of the map, and "Map data ©2021 Terms of Use" is in the bottom right.

EHR -> REDCap

Edit Field

You may add a new project field to this data collection instrument by completing the fields below and clicking the Save button at the bottom. When you add a new field, it will be added to the form on this page. For an overview of the different field types available, you may view the [Field Types video \(4 min\)](#)

Field Type: Multiple Choice - Radio Buttons (Single Answer)

Field Label Use the Rich Text Editor [?](#)

What is the participant's biological sex?

Choices (one choice per line) [Copy existing choices](#)

- 1, Female
- 2, Male
- 3, Undifferentiated
- 4, Unknown
- 5, Prefer not to answer

[How do I manually code the choices?](#)

Action Tags / Field Annotation (optional)

Learn about [@ Action Tags](#) or [using Field Annotation](#)

Variable Name (utilized in logic, calcs, and exports)
sex Enable auto naming of variable based upon its Field Label?
ONLY letters, numbers, and underscores

How to use [Smart Variables](#) [Piping](#) [Field Embedding](#)

Required?* No Yes
* Prompt if field is blank

Identifier? No Yes
Does the field contain identifying information (e.g., name, SSN, address)?

Custom Alignment Right / Vertical (RV)
Align the position of the field on the page

Field Note (optional)
Small reminder text displayed underneath field

Save **Cancel**

Variable: brthdat

Date of Birth D-M-Y

@HIDEBUTTON

Add Field **Add Matrix of Fields** **Import from Field Bank**

Variable: age

What is the participant's age? [View equation](#)

Add Field **Add Matrix of Fields** **Import from Field Bank**

Variable: rfstdtc

What is the date the participant was enrolled in the study? Today D-M-Y

Add Field **Add Matrix of Fields** **Import from Field Bank**

Variable: birth_city

What is the participant's city/municipality of birth?

Add Field **Add Matrix of Fields** **Import from Field Bank**

Variable: birth_country

What is the participant's country of birth?

Add Field **Add Matrix of Fields** **Import from Field Bank**

Variable: sex

What is the participant's biological sex?

- Female
- Male
- Undifferentiated
- Unknown
- Prefer not to answer

reset

EHR -> REDCap

Source Fields List

- **Adverse Event**
1/1 field selected
- **Allergy Intolerance**
1/1 field selected
- **Condition**
1/1 field selected
- **Core Characteristics**
2/2 fields selected
- **Demographics**
16/16 fields selected
- **Encounter**
1/1 field selected
- **Immunization**
1/1 field selected
- **Laboratory**
3764/3764 fields selected
- **Medications**
4/4 fields selected
- **Vital Signs**
123/123 fields selected

Clinical Data Pull

Clinical Data Pull

- Real-time data collection
- Prospective clinical studies/trials
- Longitudinal and/or multi-arm studies

MAP SOURCE FIELDS TO REDCAP FIELDS			
External Source Field (eStar)	Map to REDCap Field	Map to REDCap date/time field <small>(Date/time value is used with day offset to construct window of time when searching for source data)</small>	Remove mapping?
id "Medical record number" ★ Source Identifier Field	mrn "Medical record number" ▼		
Allergy Intolerance			
allergy-list "Allergy intolerance"	allergy_list "Allergy list" ▼		✘
Condition			
problem-list "Problem list and health concerns"	problem_list "Problem list" ▼		✘
Demographics			
name-family "Last name"	last_name "Last Name" ▼		✘
name-given "First name"	first_name "First Name" ▼		✘
Medications			
active-medications-list "Active medications list"	active_medications_list "Active medications list".. ▼		✘
Laboratory			
33037-3 "Anion gap in Serum or Plasma" ◆ Use same mapping for other source field	angap "Anion gap (AN-GAP)" ▼ ✘ angap_2 "Anion gap (AN-GAP)" ▼ ✘ ◆ Map other REDCap field	Date/time field: visit_date "Visit date" ▼ Preselect a value (optional): Nearest value (based on 1 ▼)	 ✘

Clinical Data Pull

Demography

✔ Study ID 5 successfully edited

Data Access Group: [No Assignment] ?

✎ Editing existing Study ID 5 (MRN: 046711373)

19 new items from source system

Study ID

5

To rename the record, see the record action drop-down at top of the [Record Home Page](#).

Medical record number

* must provide value

046711373

Preferred Language

First Name

Last Name

Gender

Ethnicity

Race

Date of birth

Today Y-M-D

Clinical Data Pull

Adjudicate data from eStar

Fetching data for **Study ID "5"** Refresh data from eStar

New items: 20 Time of last data fetch: less than a minute ago **MRN: 046711373**

Display all items (all forms)
 Display only this form's items

REDCap Field	REDCap Date/Time	eStar Source Date/Time	REDCap Current Value	eStar Source Value	Import?
Demography					
first_name "First Name"	-	-		Adam	<input checked="" type="radio"/> reset
last_name "Last Name"	-	-		Ztest	<input checked="" type="radio"/> reset
sex "Gender"	-	-		Male (M)	<input checked="" type="radio"/> reset
ethnicity "Ethnicity"	-	-		Not Hispanic or Latino (2186-5)	<input checked="" type="radio"/> reset
race "Race"	-	-		White (2106-3)	<input checked="" type="radio"/> reset
dob "Date of birth"	-	-		1984-09-05	<input checked="" type="radio"/> reset
address_street "Address (street)"	-	-		11 Elm Street	<input checked="" type="radio"/> reset
address_city "Address (city)"	-	-		FRANKLIN	<input checked="" type="radio"/> reset
address_state "Address (state)"	-	-		TN	<input checked="" type="radio"/> reset

Clinical Data Pull

Demography

✔ Study ID 5 successfully edited

Data Access Group: [No Assignment] [?]

Study ID	<input type="text" value="5"/>
Medical record number	<input type="text" value="046711373"/>
Preferred Language	<input type="text" value="English"/>
First Name	<input type="text" value="Adam"/>
Last Name	<input type="text" value="Ztest"/>
Gender	<input type="text" value="male"/>
Ethnicity	<input type="text" value="Not Hispanic or Latino"/>
Race	<input type="text" value="White"/>
Date of birth	<input type="text" value="1984-09-05"/> <input type="button" value="Today"/> Y-M-D

Clinical Data Mart

Enter medical record numbers of patients to import from the EHR (one per line, optional)

Total MRNs: 0

Choose fields in EHR for which to pull data

Source Fields List Filter: search source fields by keywords

- id (Medical record number)**
- + Demographics** select all
0/13 selected
- + Condition** select all
0/1 selected
- + Medications** select all
0/1 selected
- + Allergy Intolerance** select all
0/1 selected
- + Vital Signs** select all
0/87 selected
- + Laboratory** select all
0/3163 selected



Clinical Data Mart

- Registries
- Prospective or retrospective clinical studies/trials
- Searching for specific lab values or diagnosis codes for a cohort of patients over a set time period

Vital Signs (46)		Labs (4)		Medications (13)	
1	● Body weight: 68 (2020-03-30 18:35)	1	● Urea nitrogen [Mass/volume] in Serum or Plasma: 16 (2020-03-30 19:05)	1	● (stopped) predniSONE (DELTASONE) 1 mg tablet
2	● Body weight: 68 (2020-03-30 18:35)	2	● Sodium [Moles/volume] in Serum or Plasma: 140 (2020-03-30 19:05)	2	● (stopped) dexamethasone (DECADRON) 4 mg/mL injection 8 mg
3	● Body height: 182.9 (2020-07-29 10:35)	3	● Creatinine [Mass/volume] in Serum or Plasma: 1 (2020-03-30 19:05)	3	● (stopped) acetaminophen 160 mg/5 mL elixir
4	● Body mass index (BMI) [Ratio]: 23.7 (2020-07-29 10:35)	4	● Potassium [Moles/volume] in Serum or Plasma: 3.5 (2020-03-30 19:05)	4	● (stopped) azithromycin (ZITHROMAX) 250 mg tablet
5	● Body weight: 79.4 (2020-07-29 10:35)	+ Add new		5	● (completed) benralizumab (Fasenra) 30 mg/mL syringe subcutaneous syringe
6	● Body weight: 79.4 (2020-07-29 10:35)			6	● (stopped) levOCARNitine (CARNITOR) 100 mg/mL solution
7	● Diastolic blood pressure: 78 (2020-07-29 10:35)			7	● (stopped) INV pitavastatin or placebo (actg 5332 - irb 150075) tablet
8	● Systolic blood pressure: 135 (2020-07-29 10:35)			8	● (stopped) naltrexone microspheres (VIVITROL) IM injection extended release suspension, extended rel recon 380 mg
9	● Body weight: 79.8 (2020-10-22 08:26)			9	● (stopped) ledipasvir-sofosbuvir (Harvoni) 90-400 mg tablet
10	● Body weight: 79.8 (2020-10-22 08:26)				
11	● Body temperature: 36.8 (2020-10-22 08:26)				
12	● Respiratory rate: 16 (2020-10-22 08:26)				
13	● Diastolic blood pressure: 78 (2020-10-22 08:26)				

Utilization @ Vanderbilt

Clinical Data Pull

- Real-time data collection
- Prospective clinical studies/trials
- Longitudinal and/or multi-arm studies

Clinical Data Pull	
Data Values adjudicated by users	309,742
Records with Adjudication	24,108
Projects with values adjudicated	79

Clinical Data Mart

- Registries
- Prospective or retrospective clinical studies/trials
- Searching for specific lab values or diagnosis codes for a cohort of patients over a set time period

Clinical Data Mart	
Data Values Imported via Data Mart	35,503,098
Records with Imported Data	49,860
Projects with Data Values Imported	39

Dissemination

Epic (30)*

BJC HealthCare & Washington University
Cedars-Sinai Health System
Children's Healthcare of Atlanta
Children's Hospital Colorado
Connecticut Children's
Denver Health
Hackensack Meridian Health
Houston Methodist
Institute for Family Health
Kids Health Alliance
Mass General Brigham
Medical University of South Carolina
Memorial Healthcare System (FL)
Montefiore Medical Center
Mount Sinai Health System
New York Consortium
Norton Healthcare
NYU Langone Health
Oregon Health & Science University
Parkville EMR
Penn Medicine
Saint Luke's Health System (MO)
UC Health
UNC Health Care System
Univ of Texas MD Anderson Cancer Center
University of Arkansas for Medical Sciences
University of Miami Health System
UT Southwestern Medical Center
Wake Forest Baptist Health
Yale New Haven Health System and Yale School of Medicine

Cerner (9)

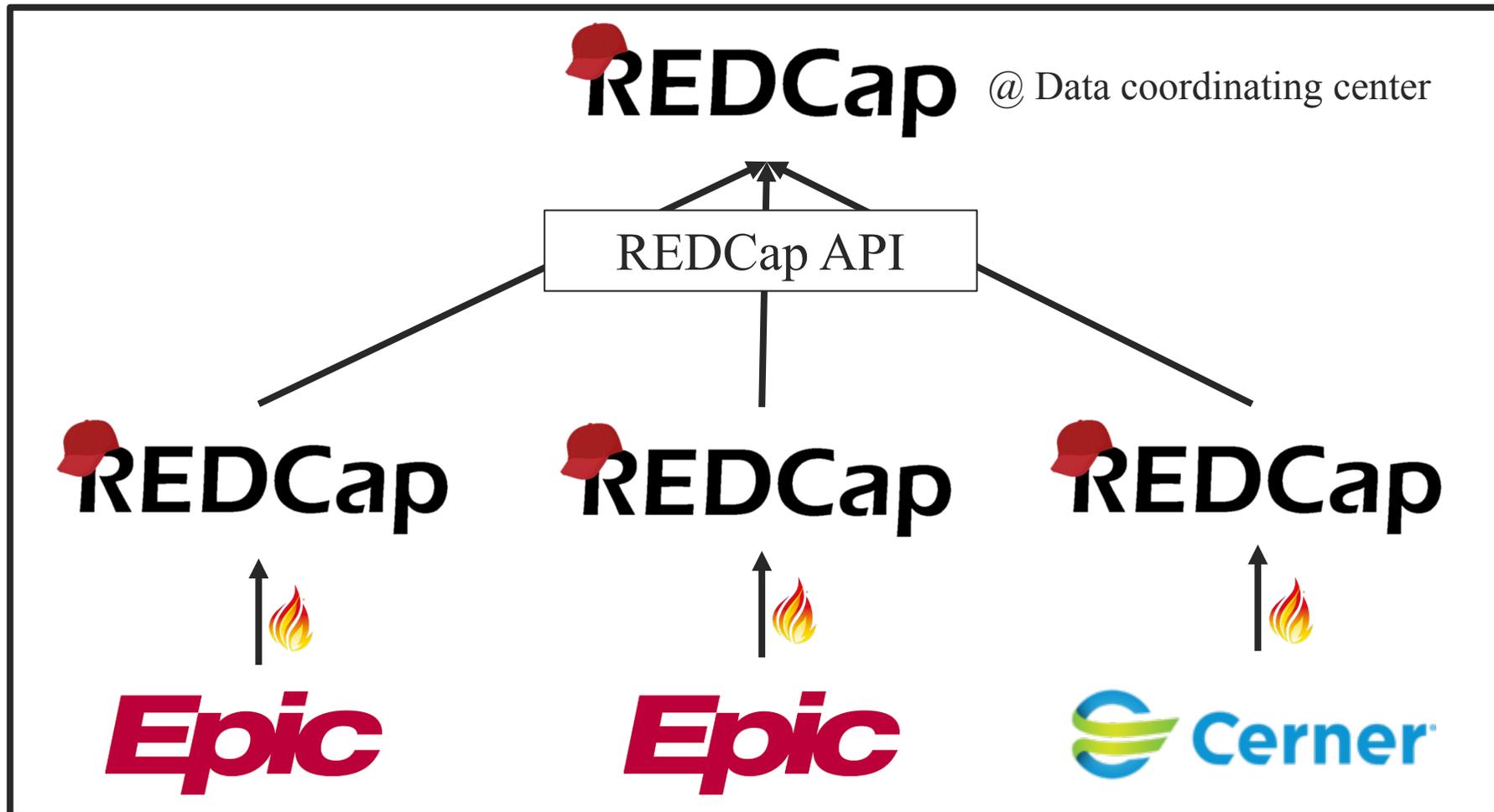
Stony Brook Medicine Information Technology (SBMIT)
Medstar
UBMD Orthopaedics & Sports Medicine
UAB
Intermountain Healthcare
University of Pittsburgh
University of Texas - Houston
UCS (University of California)
Indiana university

* 39 Institutions other have requested the App on Epic's App Orchard but have not pulled any data

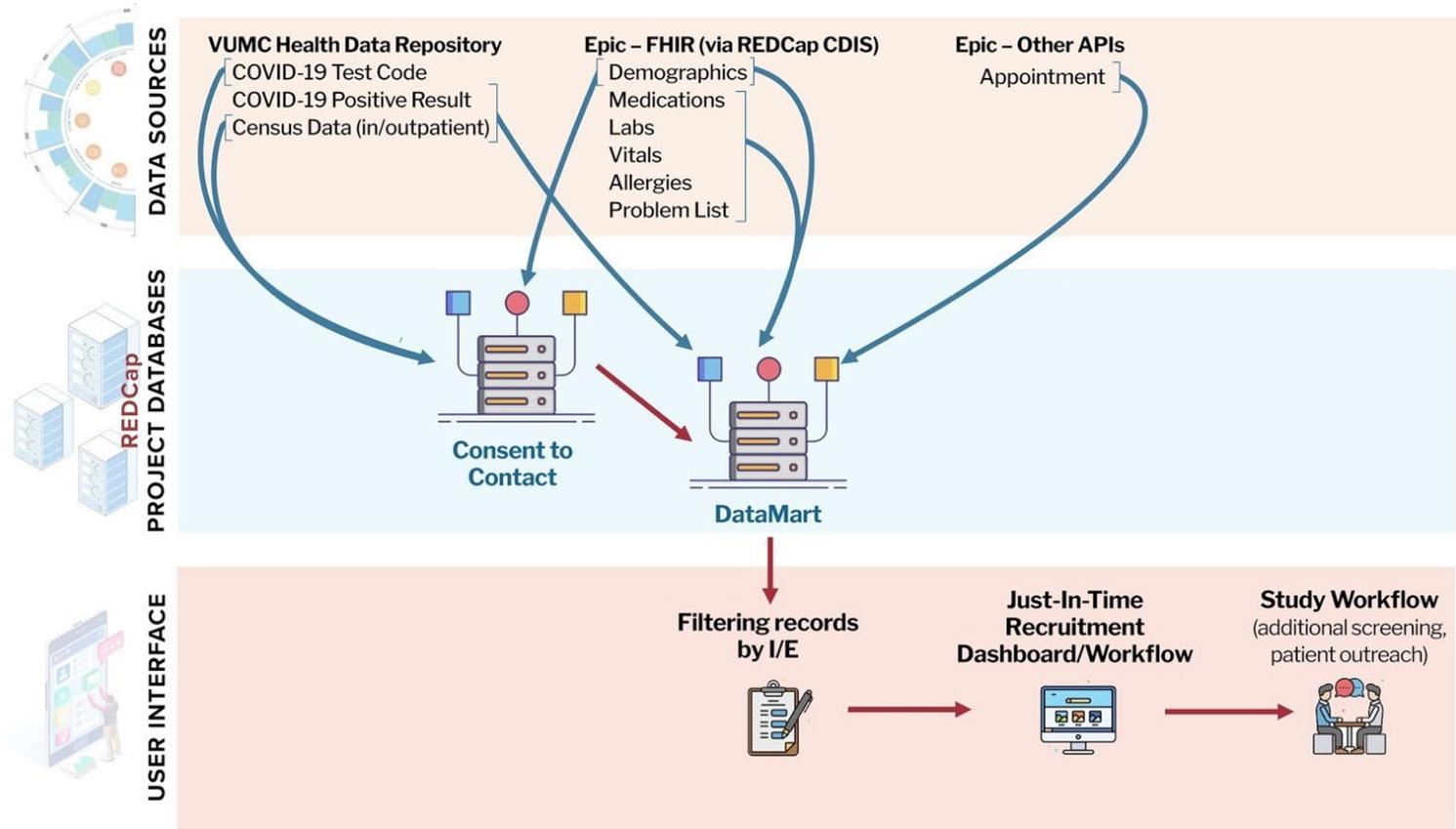
Lessons learned

- Technical
 - Break-The-Glass
 - Instant Adjudication
 - Data Mapper
 - Future-proofing new releases
- Dissemination
 - Epic App Orchard
 - Office Hours

Multi-center clinical trials



COVID-19 Registry Data Mart



Original Research

Creating and Implementing a COVID-19 Recruitment Data Mart

Tara T Helmer ^a, Adam A Lewis ^a, Mark McEver ^a, Francesco Delacqua ^a, Cindy L Pastern ^a, Nan Kennedy ^a, Terri L Edwards ^a, Beverly O Woodward ^b, Paul A Harris ^{a, c} ✉

Show more ▾

+ Add to Mendeley 🗨 Cite

<https://doi.org/10.1016/j.jbi.2021.103765>

Get rights and content

Highlights

- Equitable sharing of eligible research participants across multiple COVID-19 studies.
- Automated study eligibility determination using real-time EHR and REDCap integration.
- Researcher awareness and recruitment support using a central eligibility dashboard
- Enhancing patient privacy and limiting participant fatigue in COVID-19 research

EHR -> ResearchMatch

JOIN NOW ABOUT RESEARCHERS NETWORK TRIALS RESULTS CONTACT US LOGIN



As of right now there are:



En Español



Medical discoveries are not possible without volunteers like **you**.

Researchers need your help! Health research changes people's lives every day, but many studies end early because there are not enough volunteers. We help by matching you with research studies. Researchers need both healthy people and people with all types of conditions. Everyone can be the perfect research match!

Join Now

EHR -> ResearchMatch

Welcome

Volunteer Agreement
Account Information
Contact Information
Demographic Data
Conditions
Medications
Account Preferences

Please read the Volunteer Agreement!

What is ResearchMatch?

ResearchMatch is a free and secure tool that helps match willing volunteers with eligible researchers and their studies at institutions across the country. ResearchMatch is not a research project, it is a list of willing individuals who are interested in research. These individuals are called ResearchMatch Volunteers. ResearchMatch provides a tool that allows you to be contacted by researchers about their studies, and in some cases to provide your opinion or experience as it relates to designing a research study.

Are there any benefits, costs or risks of joining ResearchMatch as a Volunteer?

As a ResearchMatch Volunteer, you might be able to get involved with research that helps improve the health and well-being of our society. Even now, many research studies end too early since there are not enough volunteers to take part. Also, there are many people who want to join research studies, but do not know how.

[Print Agreement](#)

By clicking 'Accept', you assert that you have read this Volunteer Agreement and agree to its terms.

- Accept
- Decline
- By checking this box, I certify that I am at least 18 years old. If you are not this age, please have a parent, guardian or caretaker fill out this information.

Are you registering for yourself or for someone else as their parent, guardian or caretaker?

- Self
- Someone else

Next

EHR -> ResearchMatch

The screenshot shows a modal window with a dark green header containing navigation links: DASHBOARD, ABOUT, RESEARCHERS, NETWORK, TRIALS, RESULTS, CONTACT US, and LOGOUT. The modal title is "Use My Health at Vanderbilt to join?". Below the title, it states "Because you have a My Health at Vanderbilt account:" followed by a bulleted list of seven points. At the bottom of the modal, there are two buttons: "Join without using My Health at Vanderbilt" and "Join using My Health at Vanderbilt". The background of the page is dimmed, showing a registration form with fields for "Conditions", "Medications", and "Street Address".

Use My Health at Vanderbilt to join?

Because you have a My Health at Vanderbilt account:

- To help you complete your registration, information from your My Health at Vanderbilt chart can be used to pre-fill your registration.
- If you agree, ResearchMatch will connect to your medical record.
- **You will be asked to sign-in to your My Health at Vanderbilt account again to verify your identity.**
- **You will be asked to give your permission to allow ResearchMatch to access your personal health record.**
- If you use this process, you will see your information filled in as a suggestion as you register on ResearchMatch.
- Please check that the information is correct and decide if you want to use the suggested information as you join.
- This does not permanently link your My Health at Vanderbilt information with ResearchMatch. It is only for this one time.
- Your care provider will not be notified that you have joined ResearchMatch.

[Join without using My Health at Vanderbilt](#) [Join using My Health at Vanderbilt](#)

EHR -> ResearchMatch

Dashboard / Demographic Data

Volunteer Agreement
Account Information
Contact Information
Demographic Data
Conditions
Medications
Account Preferences

Some information below has been pre-filled based on the information from your My Health at Vanderbilt chart. You must click **Next** to have it added to your ResearchMatch profile. Please correct or reject any information that is wrong, or that you do not wish to share. You may also want to contact your healthcare provider so that your medical chart in My Health at Vanderbilt can be corrected.

Tell us about yourself

Please enter your required demographic information.

Date of birth 

Gender 

Height (ft) 

Height (In) 

Weight (lbs) 

[[toggle metric measurements](#)]

EHR -> ResearchMatch

DASHBOARD ABOUT RESEARCHERS NETWORK TRIALS RESULTS CONTACT US LOGOUT

Review your health conditions

The health conditions listed below were found on your My Health at Vanderbilt chart. Please choose the ones that you want to add to your ResearchMatch profile. You must click the box next to the condition to add it. You may check the **accept all** button to add all of the conditions.

[accept all](#)

<input checked="" type="checkbox"/> pain	<input checked="" type="checkbox"/>
<input type="checkbox"/> patient immunocompromised	<input type="checkbox"/>
<input checked="" type="checkbox"/> tension headache	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> cough	<input checked="" type="checkbox"/>
<input type="checkbox"/> essential hypertension	<input type="checkbox"/>
<input checked="" type="checkbox"/> normal pregnancy	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> allergy to peanuts	<input checked="" type="checkbox"/>
<input type="checkbox"/> nephrolithiasis	<input type="checkbox"/>

[Continue](#)

Next

Review your medications

The medications listed below were found on your My Health at Vanderbilt chart. Please choose the ones that you want to add to your ResearchMatch profile. You must click the box next to the medication to add it. You may check the **accept all** button to add all of the medications.

[accept all](#)

<input checked="" type="checkbox"/> torsemide 5 mg oral tablet	<input checked="" type="checkbox"/>
<input type="checkbox"/> tacrolimus 1 mg oral capsule	<input type="checkbox"/>
<input type="checkbox"/> tacrolimus 5 mg oral capsule	<input type="checkbox"/>
<input checked="" type="checkbox"/> glimepiride 1 mg oral tablet	<input checked="" type="checkbox"/>
<input type="checkbox"/> cyanocobalamin, 1000 mcg/ml injectable solution	<input type="checkbox"/>
<input type="checkbox"/> gabapentin 300 mg oral capsule	<input type="checkbox"/>
<input type="checkbox"/> infliximab 100mg intravenous vial (sdv,mdv or additive) (ea)	<input type="checkbox"/>
<input checked="" type="checkbox"/> lisinopril 10 mg oral tablet	<input checked="" type="checkbox"/>
<input type="checkbox"/> lactulose, 10 gm/15 ml oral syrup	<input type="checkbox"/>
<input type="checkbox"/> emtricitabine 200 mg / tenofovir disoproxil fumarate 300 mg tablet, film coated [truvada]	<input type="checkbox"/>
<input type="checkbox"/> alcohol, 70% topical pad	<input type="checkbox"/>

[Continue](#)

Enter a health condition in the box below to learn [Facebook](#) Stay informed with news from ResearchMatch.

EHR -> ResearchMatch

Dashboard / Account Preferences

Volunteer Agreement
Account Information
Contact Information
Demographic Data
Conditions
Medications
Account Preferences

Tell us your preferences

Is there anything we missed? Please share this information.

Some studies that you may learn about through ResearchMatch may require traveling to a specific site. In general, how far would you be willing to travel for these types of studies?

Less than 100 miles 

Would you like to be contacted about studies related to being a parent?

No 

Some research studies are conducted entirely by surveys. Would you like to be considered for survey-only studies? You can always change your preference at any time

Yes – I want to hear about all research opportunities 

When you get emails from ResearchMatch about research studies, what languages would you like those emails to be in?

If you only select Spanish, you may get fewer emails about research studies.

- English
- Spanish

How did you learn about ResearchMatch.org?

News Release 

Lessons learned

- Epic OAuth2 connectivity
- Engage privacy office and IRB early
- Obtain patient input from community engagement studio
 - Effectiveness
 - Coverage
 - Patient uptake

REDCap -> FHIR Server

Motivations for creating a FHIR mapping tool

- High barrier of entry to format data according to the HL7 FHIR format and send data
- Raise awareness about FHIR
- Funder requirements are coming
- Mandated in 21st century CARES Act

REDCap -> FHIR Server

Edit Field

You may add a new project field to this data collection instrument by completing the fields below and clicking the Save button at the bottom. When you add a new field, it will be added to the form on this page. For an overview of the different field types available, you may view the [Field Types video \(4 min\)](#).

Field Type: Text Box (Short Text, Number, Date/Time, ...)

Field Label Use the Rich Text Editor [?](#)

Heart rate

Action Tags / Field Annotation (optional)

```
@FHIR-MAPPING={
  "type": "Observation",
  "primaryElementPath": "valueQuantity/value",
  "additionalElements": [
    {
      "element": "status",
      "value": "final"
    },
    {
      "element": "code",
      "value": "10251-7"
    },
    {
      "element": "effectiveDateTime",
      "field": "vital_date"
    }
  ]
}
```

Learn about [@ Action Tags](#) or [using Field Annotation](#)

Variable Name (utilized in logic, calcs, and exports)

heart_rate Enable auto naming of variable based upon its Field Label?

ONLY letters, numbers, and underscores

How to use [Smart Variables](#) [Piping](#) [Field Embedding](#)

Validation? (optional) --- None ---

- or -

-- select ontology service --

FHIR Mapping

Resource: Observation

Element: valueQuantity/value

Additional Elements

Element	status	✖
Value	Final	
Element	code	✖
Value	10251-7	
Element	effectiveDateTime	✖
Field	vital_date	

[Add field](#) [Add value](#)

[Save](#) [Cancel](#)

REDCap -> FHIR Server

REDCap
Logged in as mceverm | Log out
My Projects or Control Center
REDCap Messenger
View project as user: -- select a user --

FHIR Mapping Test Project PID 123248

Record Home Page

The grid below displays the form-by-form progress of data entered for the currently selected record. You may click on the colored status icons to access that form/event. If you wish, you may modify the events below by navigating to the [Define My Events](#) page.

Legend for status icons:

- Incomplete ● Incomplete (no data saved) ?
- Unverified ● Partial Survey Response
- Complete ● Completed Survey Response

Choose action for record

- Download ZIP file of all uploaded documents
- Download PDF of record data for all instruments/events
- Download PDF of record data for all instruments/events (compact)
- View FHIR Bundle
- Validate FHIR Bundle (experimental)
- Send FHIR Bundle to remote FHIR server
- Lock entire record
- Rename record
- Delete record (all forms/events)

Form/Event	Status	Actions
Completion Data- test	Incomplete	
COVID-19 Vaccination	Incomplete	
Delete all data on event:	Incomplete	

```
{
  "resourceType": "Bundle",
  "type": "collection",
  "entry": [
    {
      "fullUrl": "https://redcap.vanderbilt.edu/api/?type=module&prefix=fhir_services&page=service&NOAUTH&fhir-url=/Patient/123248-3",
      "resource": {
        "resourceType": "Patient",
        "id": "123248-3",
        "name": [
          {
            "given": [
              "Harry",
              "James"
            ],
            "family": "Potter"
          }
        ],
        "birthDate": "1981-07-31",
        "address": [
          {
            "type": "physical",
            "line": [
              "123 Hogwarts Way"
            ],
            "city": "Spring Hill",
            "state": "TN",
            "postalCode": "37174"
          }
        ],
        "telecom": [
          {
            "value": "6218675309",
            "system": "phone",
            "use": "mobile"
          }
        ]
      }
    },
    {
      "resource": {
        "resourceType": "Observation",
        "id": "123248-3",
        "valueQuantity": {
          "value": 60
        },
        "status": "final",
        "code": {
          "coding": [
            {
              "system": "http://loinc.org",
              "code": "10251-7"
            }
          ]
        },
        "effectiveDateTime": "2020-12-30T00:00:00-06:00"
      }
    }
  ]
}
```

Lessons Learned

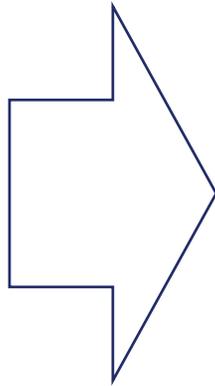
- Making things work at scale
 - Researchers don't care if it's FHIR
 - Make it easy to do the right thing
- Certain combinations of data difficult
- Customization through external modules



What Sentinel can do

Lowering barriers of entry

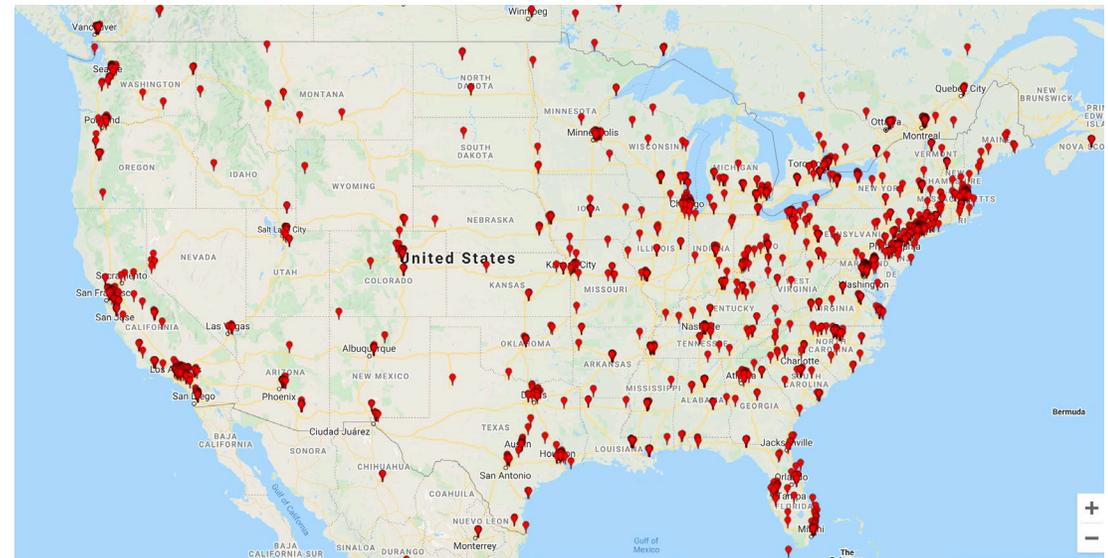
1. Aetna, a CVS Health company
2. Duke University School of Medicine: Department of Population Health Sciences (Medicare Fee-for-Service data)
3. Harvard Pilgrim Health Care Institute
4. HCA Healthcare
5. HealthCore, Inc. (Anthem, Inc. data)
6. HealthPartners Institute
7. Humana, Inc.
8. Kaiser Permanente Colorado Institute for Health Research
9. Kaiser Permanente Hawaii Center for Integrated Health Care Research
10. Kaiser Foundation Health Plan of the Mid-Atlantic States, Inc.
11. Kaiser Permanente Northern California, Division of Research
12. Kaiser Permanente Northwest Center for Health Research
13. Kaiser Permanente Washington Health Research Institute
14. Marshfield Clinic Research Institute
15. Optum (OptumInsight Life Sciences Inc. and Optum Labs®)
16. Vanderbilt University Medical Center, Department of Health Policy (Tennessee Medicaid data)



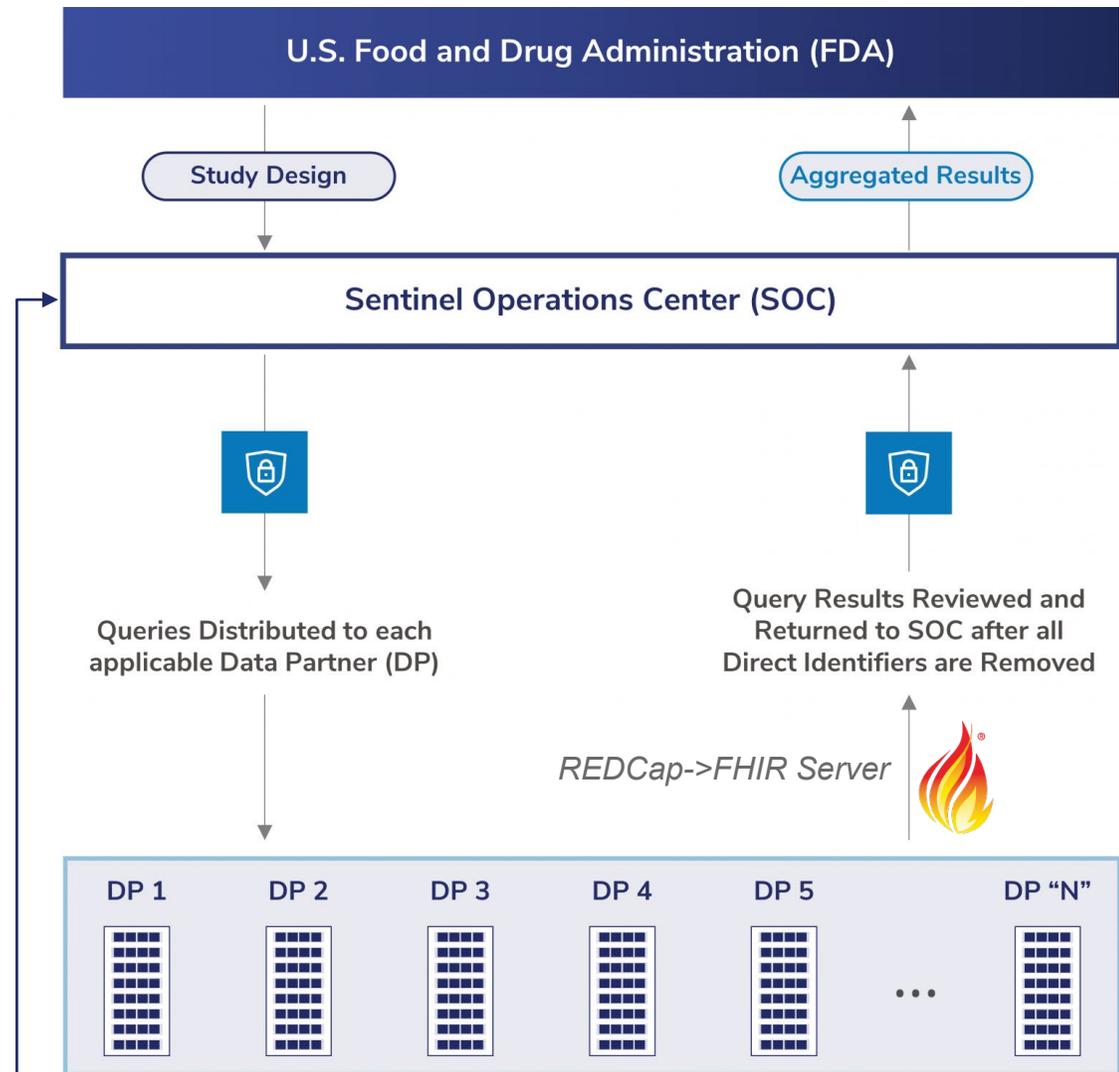
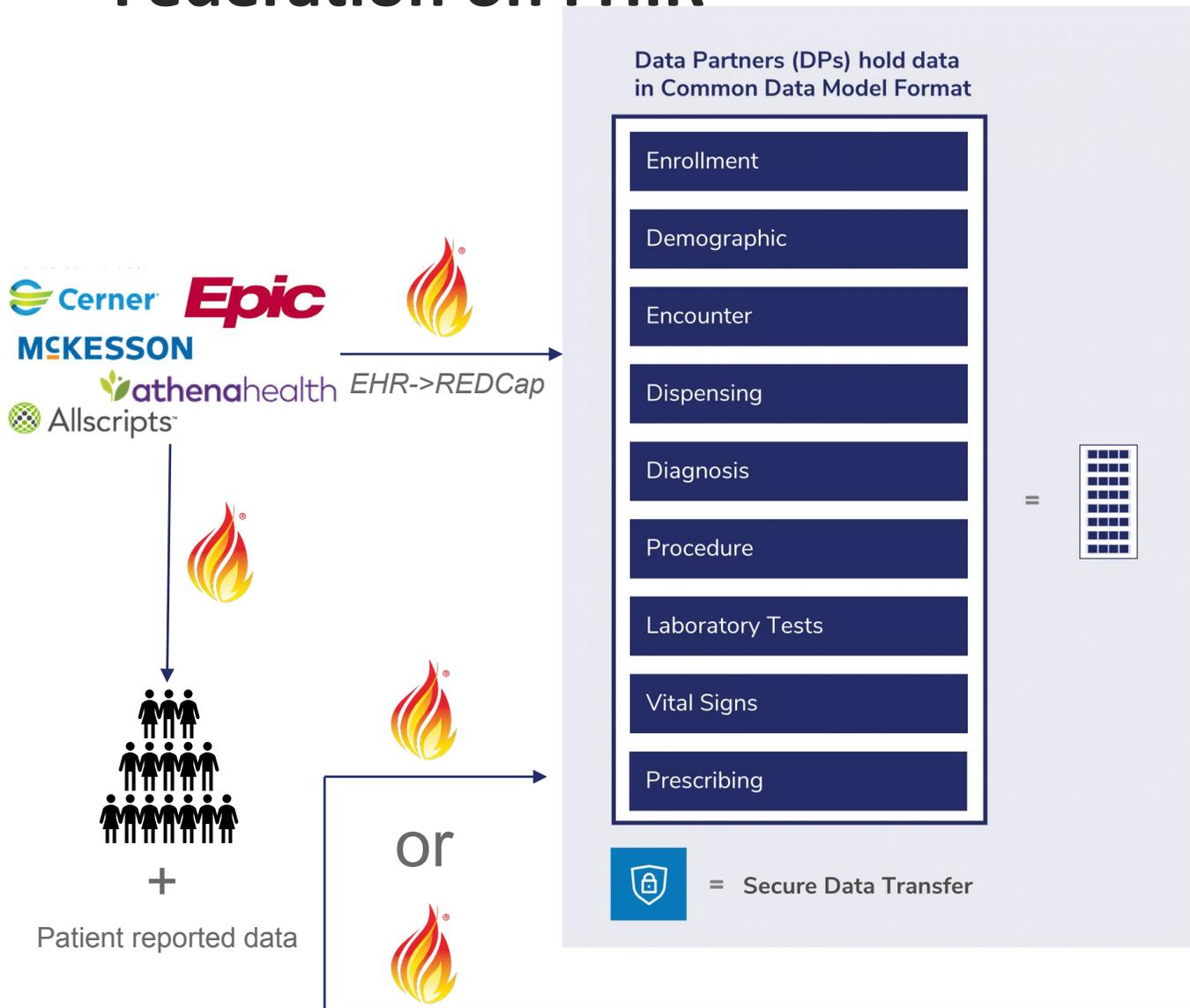
Consortium Partners (Show map)

4,982 institutions in **141** countries

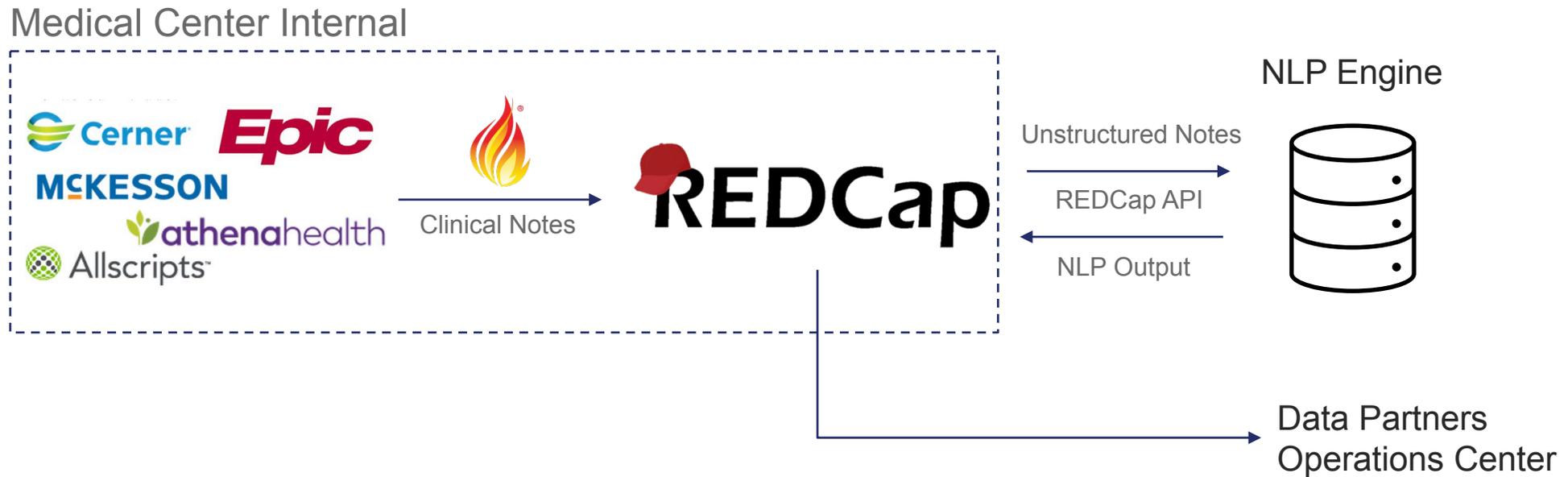
1,142,000 projects with **1,659,000** users



Federation on FHIR



FHIR Pipeline for NLP



Conclusions

- Lots of potential for FHIR to increase breadth and depth of EHR data collection
- Our development of REDCap and ResearchMatch interfaces with EHRs has identified many and overcome some of the barriers to FHIR API implementation
- Sentinel common data model is well suited for interoperability with FHIR

Acknowledgements

Vanderbilt Office of Research Informatics

- Paul Harris PhD
- Stephany Duda PhD
- Rob Taylor MA
- Francesco Delacqua
- Adam Lewis MS
- Katie Banasiewicz
- Mark McEver

UT Southwestern

- Teresa Bosler

Let's make FHIR work!

Alex Cheng

a.cheng@vumc.org

@thatAlexCheng

Sentinel CDM

Sentinel Common Data Model

Administrative Data							Clinical Data	
Enrollment	Demographic	Dispensing	Encounter	Diagnosis	Procedure	Prescribing	Lab Result	Vital Signs
Patient ID	Patient ID	Patient ID	Patient ID	Patient ID	Patient ID	Patient ID	Patient ID	Patient ID
Enrollment Start & End Dates	Birth Date	Provider ID	Encounter ID & Type	Encounter ID & Type	Encounter ID & Type	Encounter ID	Result & Specimen Collection Dates	Measurement Date & Time
Medical Coverage	Sex	Dispensing Date	Service Date(s)	Provider ID	Provider ID	Prescribing ID	Test Type, Immediacy & Location	Height & Weight
Drug Coverage	Postal Code	Rx	Facility ID	Service Date(s)	Service Date(s)	Provider ID	Logical Observation Identifiers Names and Codes (LOINC®)	Diastolic & Systolic BP
Medical Record Availability	Race	Rx Code Type	Etc.	Diagnosis Code & Type	Procedure Code & Type	Order Date	Etc.	Tobacco Use & Type
	Etc.	Days Supply		Principal Discharge Diagnosis	Etc.	Rx Source		Etc.
		Amount Dispensed				Rx Route of Delivery		
						Etc.		

Registry Data			Inpatient Data		Mother-Infant Linkage Data	Auxiliary Data	
Death	Cause of Death	State Vaccine	Inpatient Pharmacy	Inpatient Transfusion	Mother-Infant Linkage	Facility	Provider
Patient ID	Patient ID	Patient ID	Patient ID	Patient ID	Mother ID	Facility ID	Provider ID
Death Date	Cause of Death	Vaccination Date	Encounter ID	Encounter ID	Mother Birth Date	Facility Location	Provider Specialty & Specialty Code Type
Death Imputed Date	Source	Admission Date	Rx Administration Date & Time	Transfusion Administration ID	Encounter ID & Type		
Source	Confidence	Vaccine Code & Type	National Drug Code (NDC)	Administration Start & End Date & Time	Mother Admission & Discharge Date		
Confidence	Etc.	Provider	Rx ID	Transfusion Product Code	Child ID		
Etc.		Etc.	Route	Blood Type	Child Birth Date		
			Dose	Etc.	Mother-Infant Match Method		
			Etc.		Etc.		

Sentinel CDM -> FHIR Mapping

Sentinel Data Element	FHIR Data Element	FHIR Resource/Profile/Extension
Table : DEMOGRAPHIC		
PatID	Patient.identifier	us-core-patient
Birth-Date	Patient.birthDate	us-core-patient
Sex	Patient.extension: us-core-birthsex	us-core-patient
Hispanic	Patient.extension: us-core-ethnicity	us-core-patient
Race	Patient.extension: us-core-race	us-core-patient
Zip	Patient.address	Patient
Zip_Date	Patient.address.period	Patient
Table : ENCOUNTER		
EncounterID	Encounter.id	us-core-encounter
PatID	Encounter.subject	us-core-encounter
ADATE	Encounter.period	us-core-encounter
DDATE	Encounter.period	us-core-encounter
Provider	Encounter.participant.individual.id	us-core-encounter, us-core-practitioner
Facility_Location	Encounter.location.location.address	us-core-encounter, us-core-location
EncType	Encounter.class	us-core-encounter
Facility_Code	Encounter.location.location.identifier	us-core-encounter, us-core-location
Discharge_Disposition	Encounter.extension (Proposed Name: discharge-disposition: CodeableConcept) : or Observation.code, Observation.value[x]	us-core-encounter or us-core-observationresults
Discharge_Status	Encounter.location.location.type	us-core-encounter,us-core-location
DRG	Encounter.extension (Proposed Name: drg : CodeableConcept)	us-core-encounter
DRG_Type	Encounter.extension (Proposed Name: drg-type : CodeableConcept)	us-core-encounter
Admitting_Source	Encounter.hospitalization.admitSource or Encounter.hospitalization.origin(location).type	us-core-encounter, us-core-location