Leveraging OUHSC Clinical Data Warehouse to Inform Research & Practice

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Terms

- **EMR** (or EHR): Electronic Medical/Health Records

  A huge database with patient records used by providers

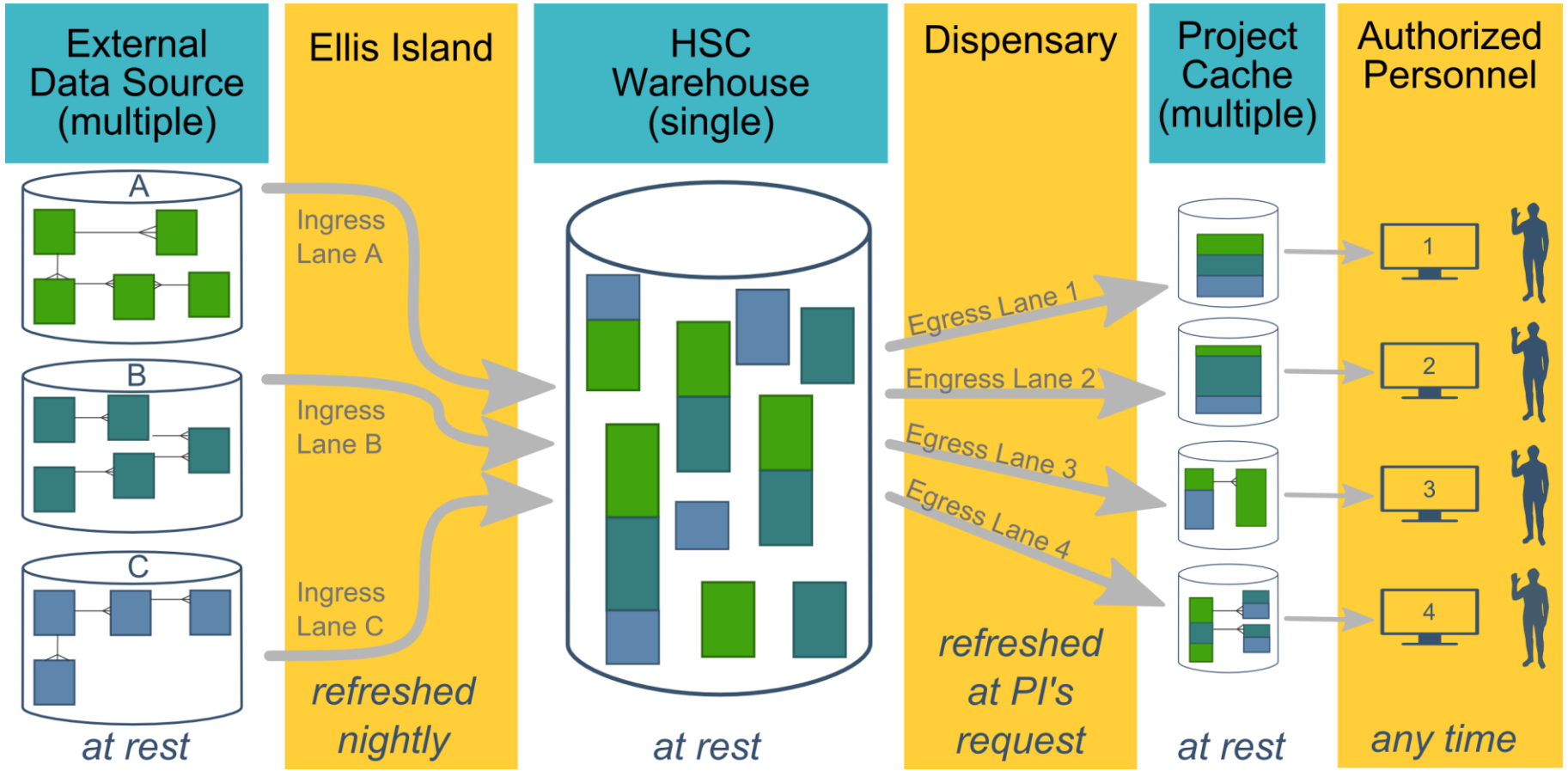
- **CDW**: Clinical Data Warehouse

  A collection of databases (such as EMRs and project-specific datasets) that has been transformed to make research more efficient and complete

Prairie Outpost – CDW (Clinical Data Warehouse)

https://github.com/OuhscBbmc/prairie-outpost-public

Ecosystem Architecture

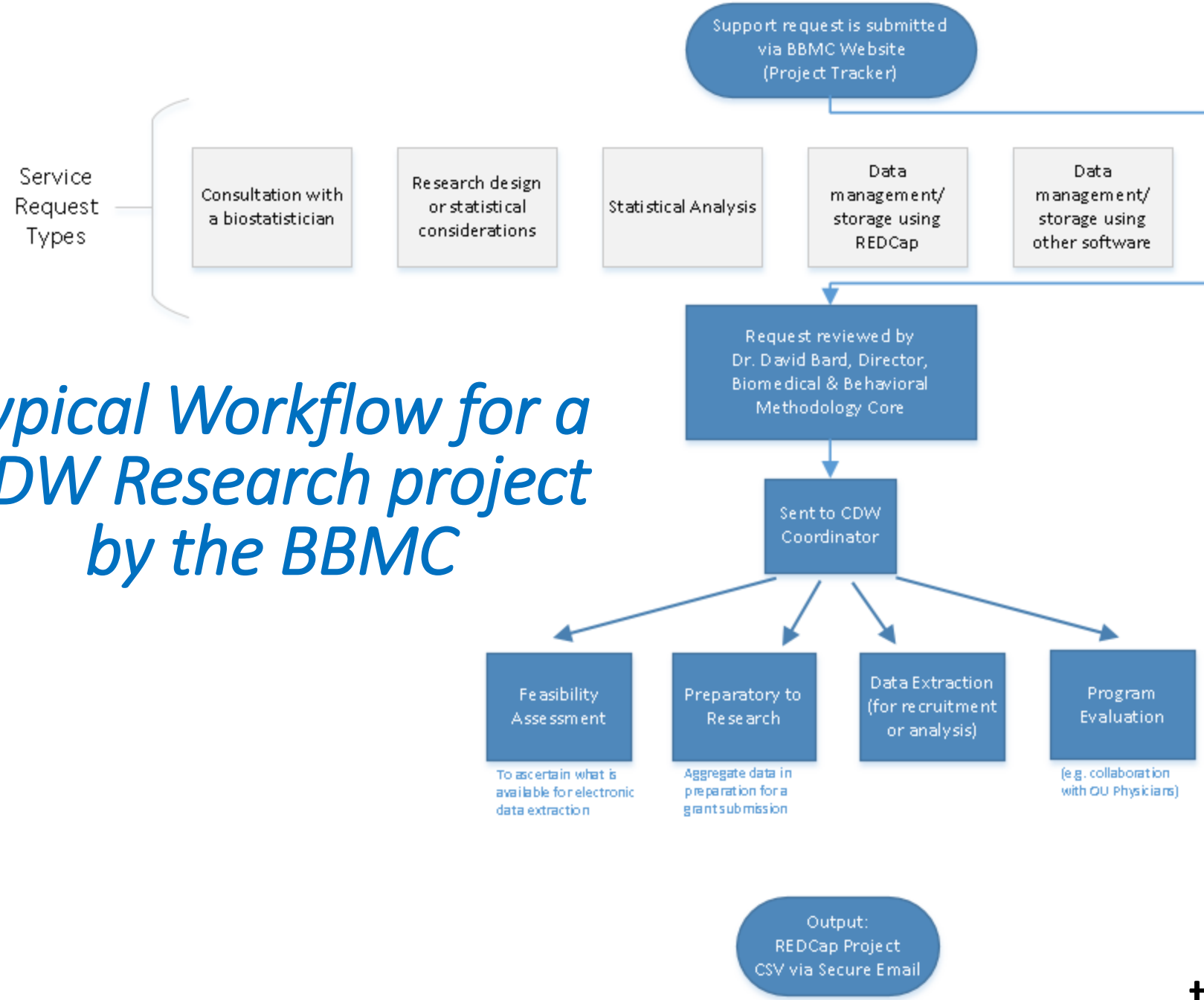


- **Data Source** (column 1): contains unique info
- **Warehouse** (column 3): contains copy after manipulation
- **Project Cache** (column 5): contains copy of copy after a lot of manipulation

HSC Data Sources

- Patient
  - Outpatient (Centricity)
  - Billing and Claims Data
  - Inpatient (Meditech)
  - Dozens of departmental sources
  - Biomedical Research Data
  - Epic (in ~1 year)
- Provider
- External Agencies
  - Service Provided (by the Health Dept of Oklahoma)
  - Child Protective Services (Oklahoma Dept of Human Services)
  - SoonerCare (Oklahoma Medicaid)
  - Immunization (Health Dept of Oklahoma)
  - Vital Records (Health Dept of Oklahoma)
  - …
  - Multi-state collaborations (in the future)
- Administrative Cost
- Employee & Student

Typical Workflow for a CDW Research project by the BBMC



Submit a request at:

ouhsc.edu/bbmc/

then ‘Request Support’

Commonly Requested CDW Support Services

- Feasibility assessment in preparation for research
  (20% of projects; 10% of CDW staff time)

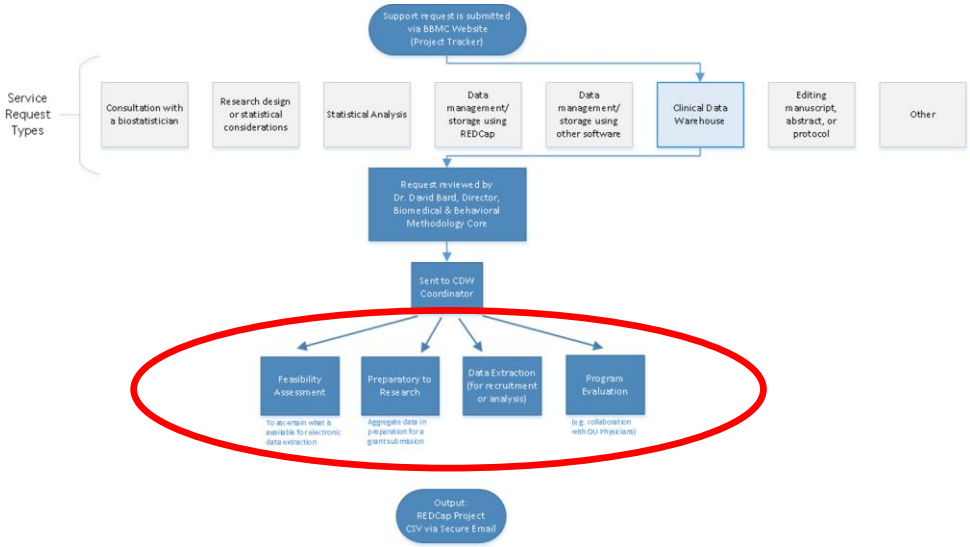
- Static eligibility
  (70% of projects; 20% of CDW staff time)
  - Virtually all projects require identification of a patient pool

- Rolling eligibility
  (30% of projects; 30% of CDW staff time)
  - Remember study team's assessment of eligibility as well as the participant's response
  - Daily automation requires stability & good logging;
    e.g., a 3 hour delay might mean zero subjects are enrolled

- Clinical outcomes for retrospective investigations
  (50% of projects; 30% of CDW staff time)

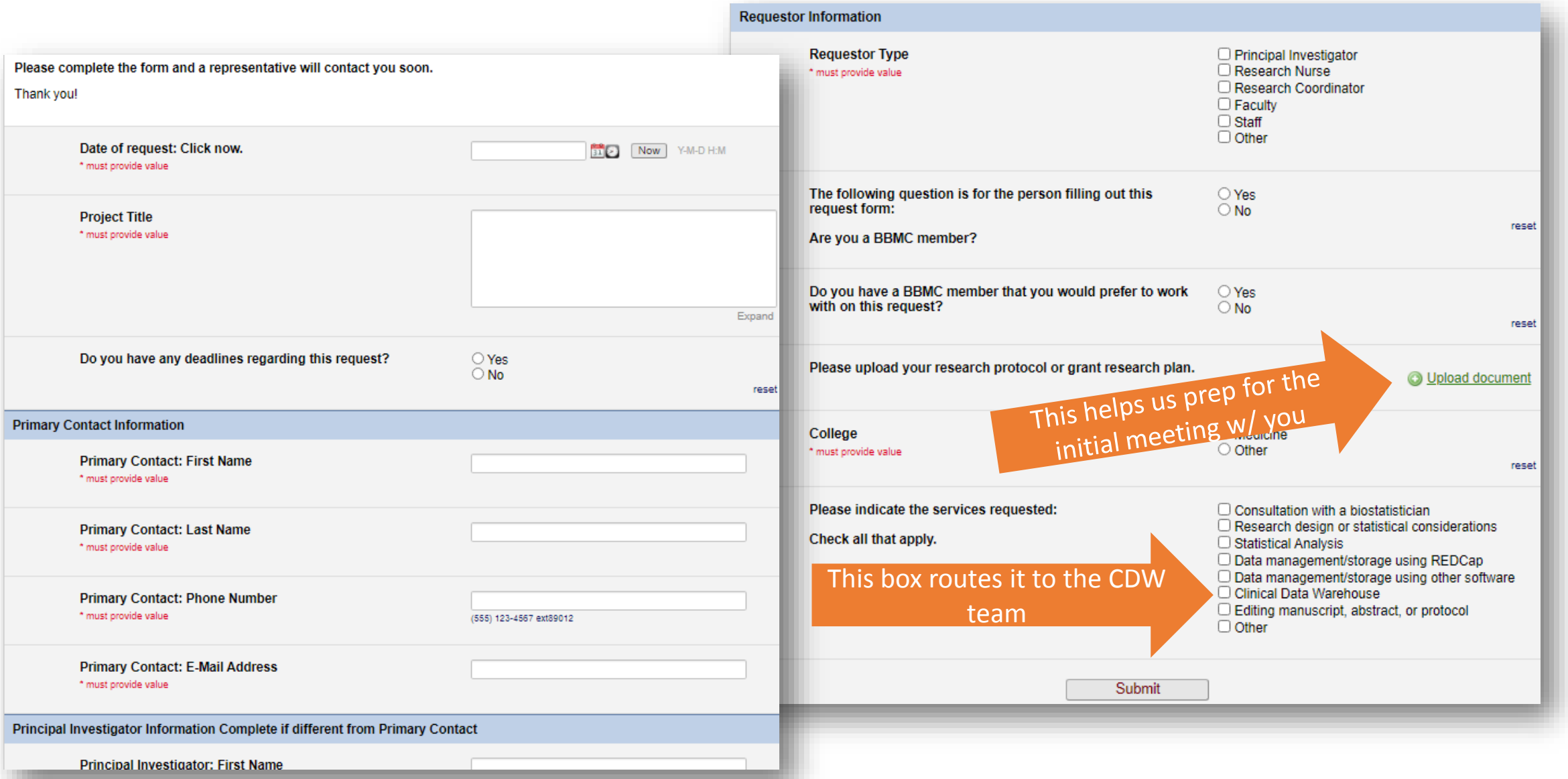
- Administrative outcomes for quality improvement
  (10% of projects; 2% of CDW staff time)

- Program evaluation
  (20% of projects; 8% of CDW staff time)



Starting a CDW Project

Submit a request at https://ouhsc.edu/bbmc/, then click “Request Support”



Rule of Thumb for Involving CDW Team

- A one-time Meditech extract:
  contact OU Medicine directly *or* we're happy to help structure the request
  Meditech request: https://ouhealth.service-now.com/sp?id=sc_cat_item&sys_id=79c250c74f652300ed7229dd0210c7d9

- Recurring Meditech extracts for rolling recruitment:
  please contact the BBMC about the CDW (https://ouhsc.edu/bbmc/)

- Research involving merged Centricity & Meditech:
  please contact the BBMC about the CDW (https://ouhsc.edu/bbmc/)

- Research involving (a) data collection outside the EMRs or (b) supplementing chart review:
  please contact the BBMC about REDCap (https://ouhsc.edu/bbmc/)

Terms

- Centricity EMR: clinical info for outpatients since ~2010
- Centricity Business: scheduling & billing info for outpatient since ~2010
- Meditech: EMR for ED & inpatients since the bronze age
- Epic: Upcoming EMR that will replace Centricity, Meditech, and many others. May not be useful for your research (at least in time to start your fellowship research project)
- REDCap: campus-recommended software for collecting PHI outside the EMRs (https://www.project-redcap.org/)

POPS Study

Pharmacokinetics of Understudied Drugs Administered to Children per Standard of Care

POPS Overview

- Primary Aim: Evaluate PK of understudied drugs administered to children

- Part of Oklahoma Pediatric Clinical Trial Network (OPCTN), a site for the NIH-funded ECHO IDeA States Pediatric Clinical Trials Network (ISPCTN)

- Enrollment Criteria:
  - Child receiving understudied drug of interest (DOIs) per standard of care
  - meet age range or condition (pre-term, obese, ECMO) open for enrollment.

Drug of Interest (DOI)	Target Ages									≤ 20 years[1]	
	Pre-term	<1 mo	1 mo-2 Yrs			2-12 Yrs			13-16 Yrs	17-20 Yrs	Obese	ECMO
			1-5 mos	6-11 mos	1 Yr	2-4 Yrs	5-8 Yrs	9-12 Yrs				
alfentanil (IV)[16]		X	X	X	X	X	Closed	Closed			X	X
amikacin[5]	X	X	X	X	X	X	X	X	X	X	X	
atropine (IV)[14]		X	X	X	X	X	X	X	X	X	X	X
cefepime[5]	X	X	X	X	X	X	X	X	X	X	X	
ceftazidime											X	X
cidofovir											X	
ciprofloxacin											X	
clozapine[4]		X	X	X	X	X	X	X	X	X	X	X
dexmedetomidine[13]		Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	X	X	X
diazepam											X	
etomidate[7, 16]		X	X	X	X	X	X				X	X
fosphenytoin											X	
haloperidol[4]		X	X	X	X	X	X	X	X	X	X	X
heparin (low molecular weight)[8]		X	Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed	X	X
hydromorphone[15, 16]		Closed	Closed	Closed	Closed	Closed	Closed	Closed	Closed		X	X
lidocaine (IV)		X	X	X	X	X	X	X	X	X	X	X
furasidone[4]		X	X	X	X	X	X	X	X	X	X	X
meropenem (IV)[2, 5]	X	X	X	X	X	X						
methylprednisolone[11] (See special	1. Age ≤30 days on the day of surgery											

Resource Efficiency: fewer patients, quicker review, less redundancy

Old System

2019-01-12 Inpatient Extract

- Finds patients who received a drug of interest
- 109 unique patients
- Record review: ~15 min/pt
- ~1,635 minutes

2019-01-13 Inpatient Extract

- 112 unique patients @15 min/pt (*forgets* yesterday)

New System

2019-01-12 Inpatient Screening Report

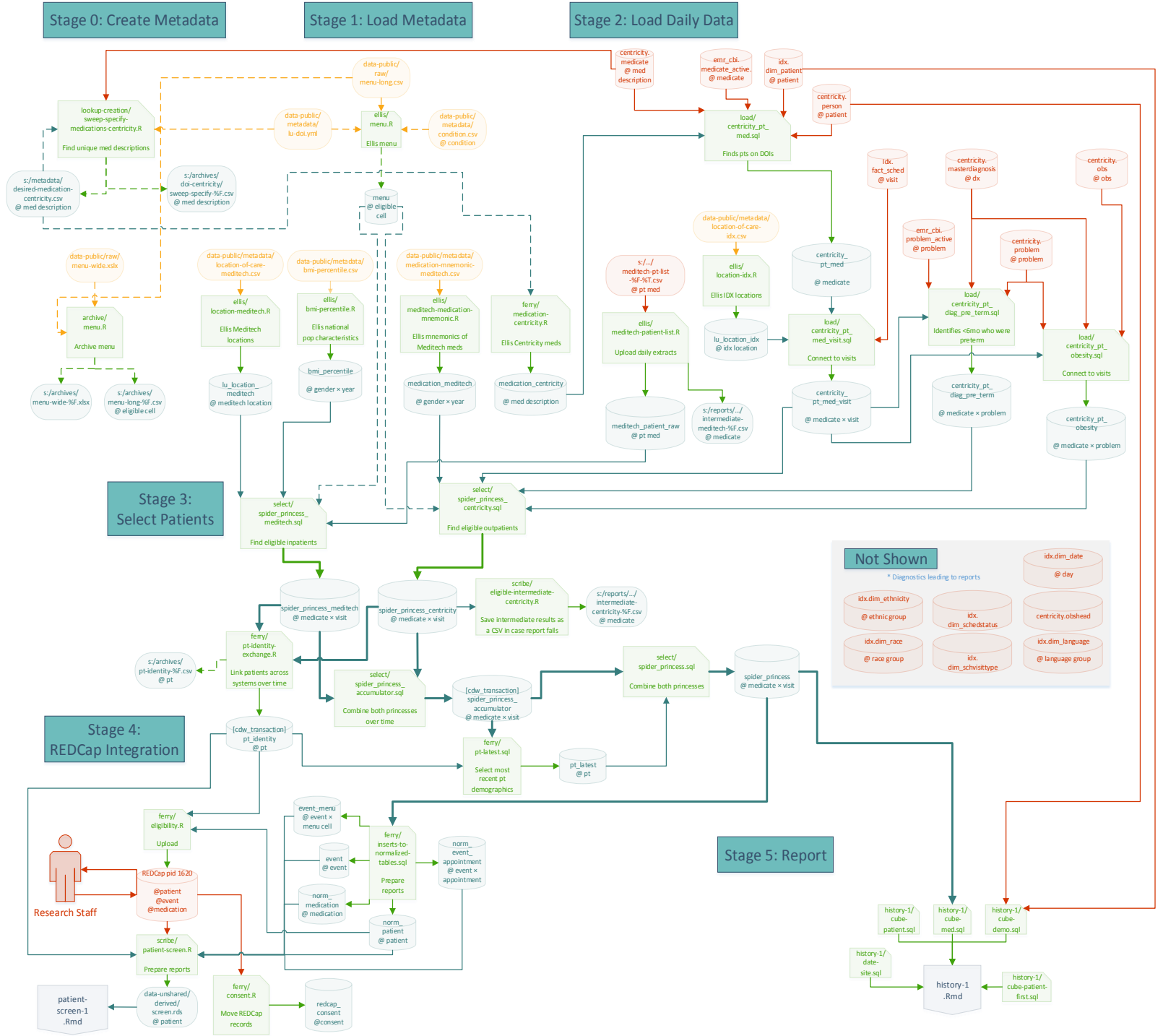
- Finds patients who received a drug of interest *and meet an age range or condition currently open for enrollment*
- 31 unique patients
- Record review: ~5 min/pt
- ~155 minutes

2019-01-13 Inpatient Screening Report

- 6 new patients @5 min/pt (*remembers* yesterday)

Enrollment Rate by Institution

ISPCTN Sites	Total # enrolled since activation	Months since activation	Average enrollment per month
Alaska Native Medical Center	2	13	0.15
Children's Mercy Hospitals and Clinics	19	11	1.73
Dartmouth-Hitchcock Medical Center	8	6	1.33
Kapiolani Women's and Children's Medical Center	9	8	1.13
Oklahoma University Medical Center	59	7	8.43
Rhode Island Hospital	46	11	4.18
Tulane University Health Science Center	4	14	0.29
University of Kansas Medical Center	2	2	1.00
University of Mississippi Medical Center	16	9	1.78
University of Montana	12	10	1.20
University of Nebraska Medical Center	14	12	1.17
University of New Mexico, Health Sciences Center	15	15	1.00
University of South Carolina - Palmetto Health	19	14	1.36
University of Vermont Medical Center	2	9	0.22
West Virginia University Hospital	9	13	0.69
Alfred I. duPont Hospital for Children	150	68	2.21
Arkansas Children's Hospital Research Institute	69	91	0.76
Medical University of South Carolina Children's Hospital	90	82	1.10
University of Louisville Norton Children's Hopsital	138	89	1.55



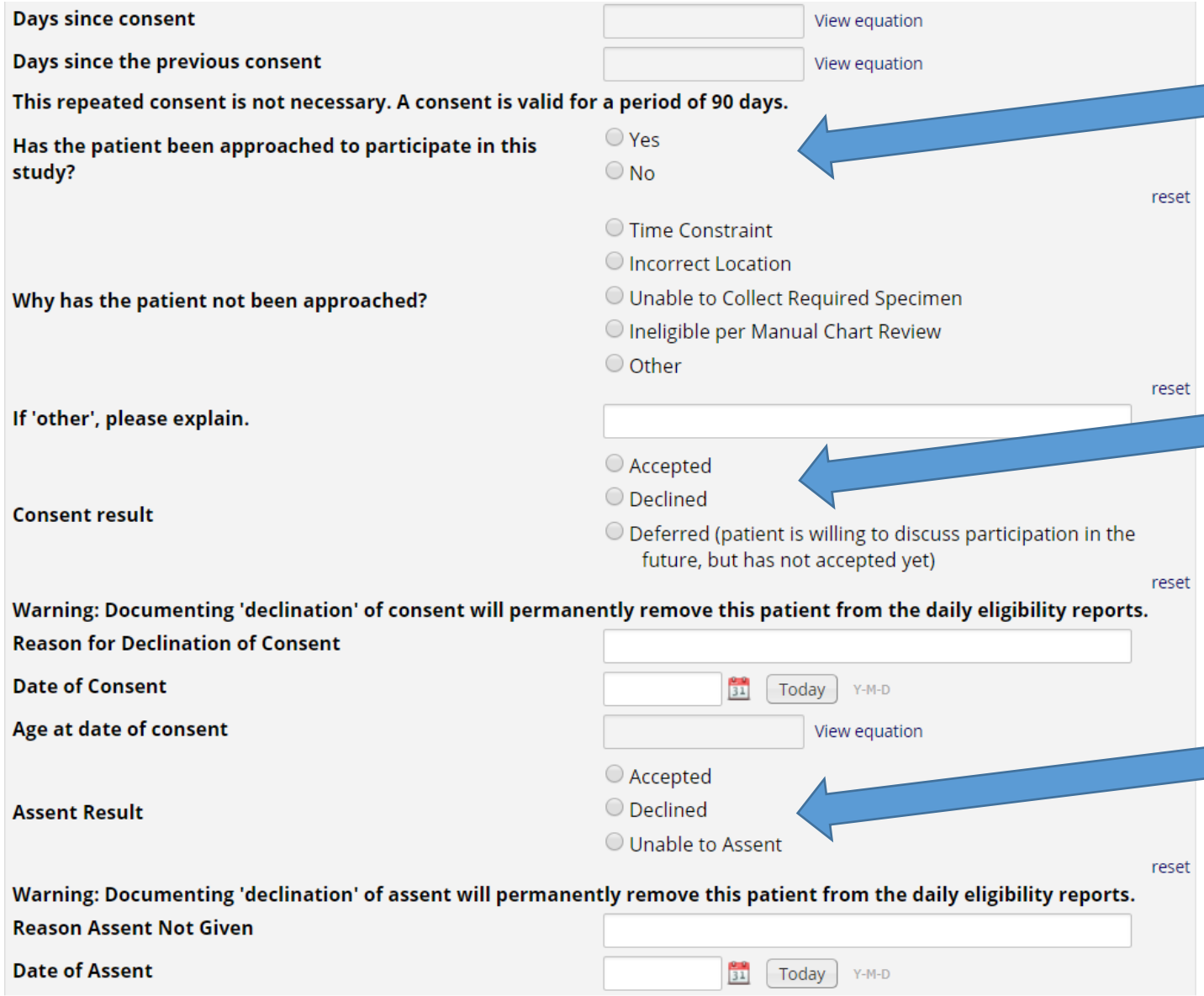
Screening Reports (for outpatients)

- Shows upcoming appointments of potentially eligible patients
  - Location of care
  - Appt Date & time
  - Qualifying medication (*e.g.*, Diazepam)
  - Qualifying condition (*e.g.*, obese, 24 months old)
  - Similar inpatient process was developed

- Eligible Patients for POPS

(Simulated patients)

REDCap Project

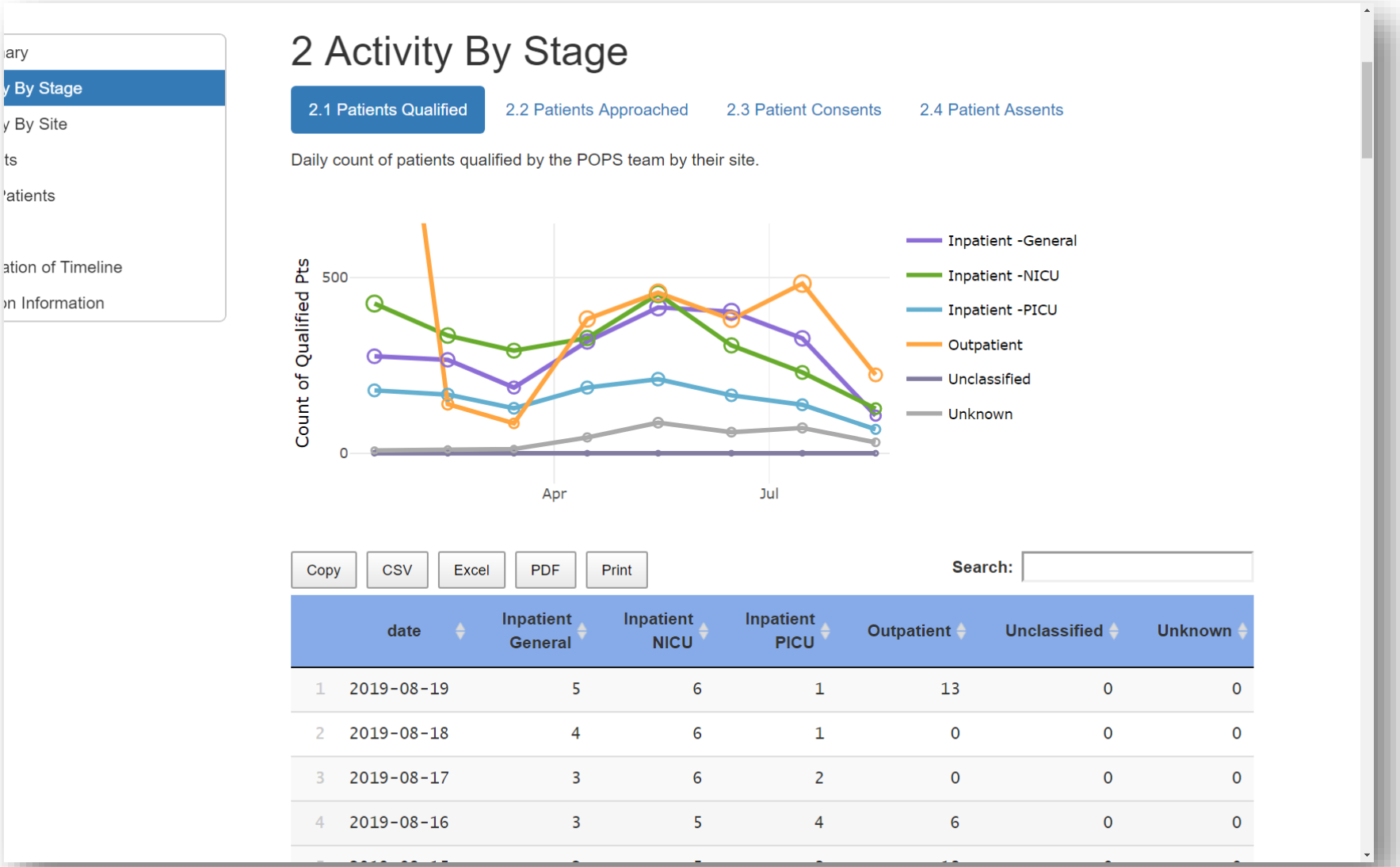


Approached?

Consented?

Assented?

Progress Reports



See the forest.

3-way breakdowns of:

- time
- site
- drug
- age
- gender
- stage
    1. qualified
    2. approached
    3. consented
    4. assented

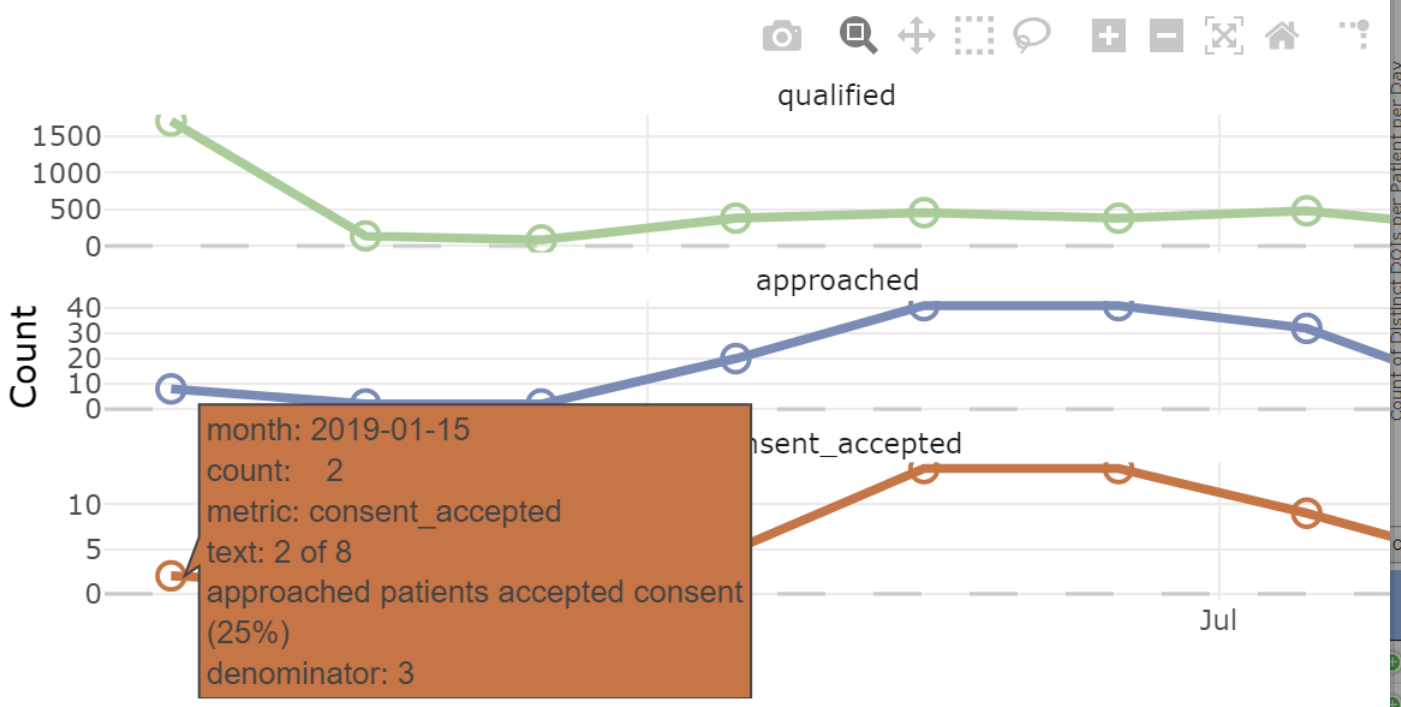
Progress Reports

3 Activity By Site

Summary of screening and recruitment acitivities by site.

3.1 General | 3.2 NICU | 3.3 PICU | **3.4 Outpatient**

Daily count of patients qualified by the POPS team by their site.



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6 DOI

6.1 Overall

The DOI per day is calculated by (a) counting the orders of a DOI and then (b) dividing by the daily count of unique patients. Since a patient may receive more than one DOI order on a single day, the DOI percentages will exceed 100%.

The histogram represents 'Sum of Daily Medication Counts': (out of 34,867 total medication-days across 237 days)'. Sum of Daily Medication Counts'. The uniqueness of the DOI is considered; a patient eligible for three variations of the same DOI will lengthen the bar by only 1.

he spaghetti represents the count of each DOI during a given day.

Copy | CSV | Excel | PDF | Print

Search:

	date	patient count	amikacin	aminocaproic acid	bosentan	cefepime	cidofovir
1	2019-08-19	77	0	16	7	0	0
2	2019-08-18	14	0	1	0	0	0
3	2019-08-17	74	0	16	7	0	0

National Registry Example: COVID-19 CDW Registry Based on OMOP

National Registry

- Institutions from 20+ states combine covid data from their EMRs

- There's a national movement for investigations to be informed by multiple sites/institutions. Every research study and institution collects their data differently.

- A CDM (common data model) is a standardized convention to store & describe data. Institutions extract and transform their EMR data

- See https://ncats.nih.gov/ and https://ncats.nih.gov/n3c

Thank you

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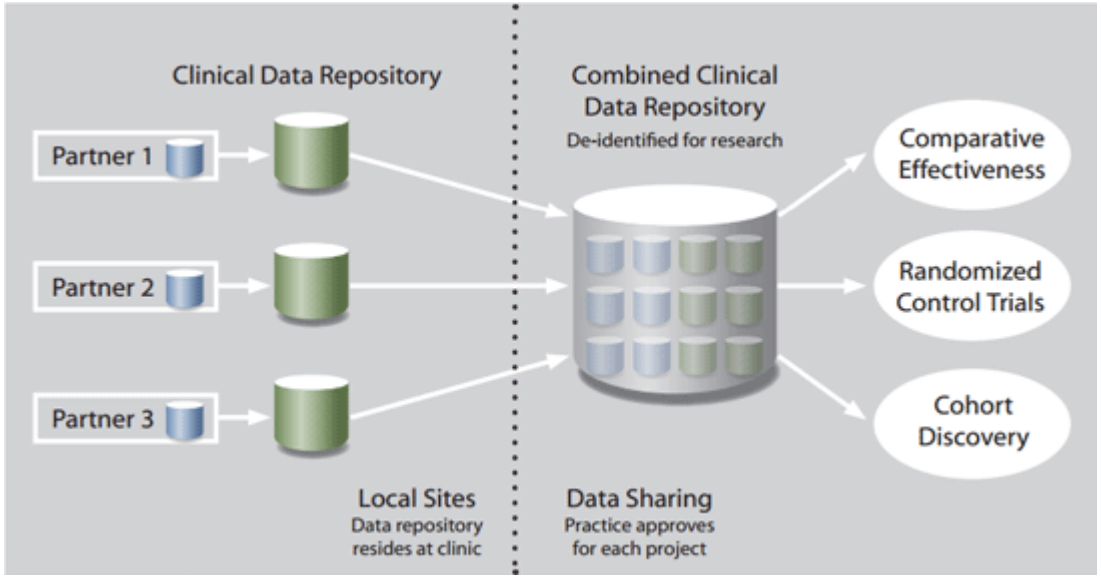
Extra Slides

Where Other Universities are Headed

- University of Washington:
  - Data Quest (https://dataquest.iths.org/)
  - Leaf- Integrates of Regulatory Oversight with Data Accession
    - De-identified prep to research
    - PHI access
- TriNetX
  - Attract Industry-Sponsored Trials
  - Peer-institution Collaborations
- University of Michigan
  - EMERSE (Electronic Medical Records Search Engine; http://project-emerse.org/)
    - Google for your free text EMR documents and notes
    - Similar to natural language processing (NLP)



LEAF

UNIVERSITY of WASHINGTON

ITHS | Institute of Translational Health Sciences
ACCELERATING RESEARCH. IMPROVING HEALTH.

About LEAF

- Self-service web application for querying and extracting clinical data
- Flexible biomedical concept system to define hierarchical items and ontologies
- Drag & drop user interface
- Designed to seamlessly integrate with existing enterprise user authentication systems and clinical databases
- Produces results which are identifiable (with IRB approval) or de-identified

Potential Uses

- Cohort discovery: determine if enough patients meet a given set of conditions which match recruitment criteria
- Statistics: quickly pull numbers, “How many patients were seen last month?”
- Chart Abstraction: Generate a dataset for research or quality improvement purposes

https://www.iths.org/

Brief Summary of CDW Value

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- POPS: dynamic recruitment
- OxyContin: electronic sorting and merging/patient matching
- ADHD studies: Apply standard clinical vocabulary to support interoperability to help information exchange; isolated retrieval of text documents for mining
- Diabetes Management/Transition of Care: Sharing of data across various sources improves quality of care and efficiency; maximizes utility of data
- Immunization: Harmonization of records for quality reporting and improved accuracy of record history

Tung-ibd-1

Tissue Eosinophil Count in IBD patients

Steps to Leverage EMR “documents”

CDW-level tasks

- (Notes are stored as multiple rows --2k characters per “document”)
- Concatenate the 2-4,000 rows per document
- Strip the RTF.
  (RTF is a markup language that specifies cosmetics like font size and color.)
- Include a search index (similar to a book index) that makes searches & parsing more efficient

Project-specific tasks

- Identify keywords that might indicate the document contains a relevant lab.
- Extract the **stem** and **result**
  - eg, “**normal fecal flora** (moderate growth)”
  - eg, “**negative** for **salmonella**, **shigella**, and **campylobacter**”