Researcher Access to Clinical Data

Introduction to Clinical Research

July 25, 2013

Diane Alejo
Diana Gumas
Sam Meiselman
David Plaut
Chris Shafer
David Thiemann, MD

1

Where do researchers get data?

TODAY

- **Electronic Patient Record (EPR) – 4M patients**
- **Allscripts / Sunrise Clinical Manager (JHH – inpatient)**
- **Meditech (Bayview)**
- **Many Departmental Systems (ED, OR, Anesthesia)**
- **Multiple result reporting systems (Lab, Rad, etc)**
- **IDX (professional fees)**
- **Casemix Datamart (diagnoses, procedures)**

This is NOT an exhaustive list!

FUTURE – an "Epic" opportunity

2

Methods for Data Access

Historically: Researcher Negotiates Access With Clinical System Technical Staff

-Logistically & technically challenging

3

Approaches for Data Access

Back end or informal access underestimates the complexity of the data and likely violates HIPAA and JHM PHI protection policies

Approved access points:

1. **Clinical Research Management System (CRMS)**
2. **EPR2020** - researcher self-serve for patients on your studies
3. **Center for Clinical Data Analysis (CCDA) Service**
4. **I2b2 cohort discovery tool**
5. **caTissue – Biospecimen data**

4

1. Clinical Research Management System (CRMS)

CRMS Contains:

- **Administrative data about your study & participants**
- **Can create research "Forms"**

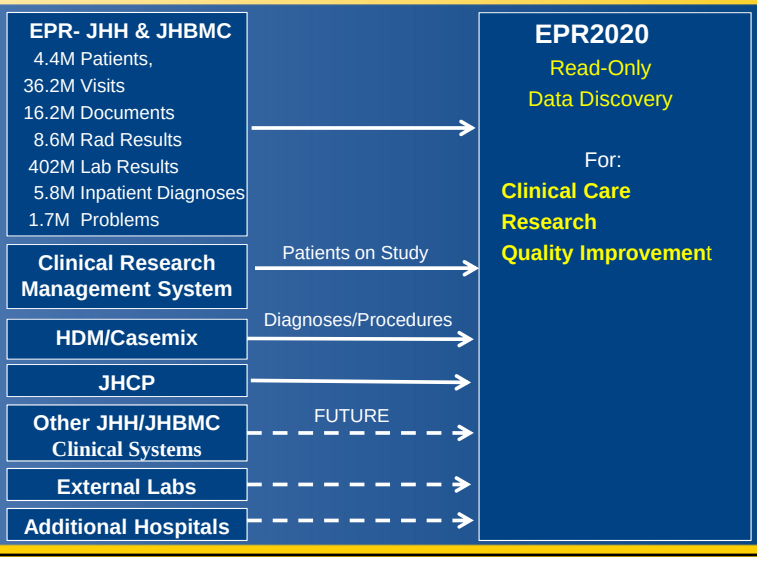
You can extract data from CRMS via

- Canned Reports (e.g. enrollment report, demographics)
- Ad-hoc querying using SQL database language

For more info:
CRMSHelp@jhmi.edu

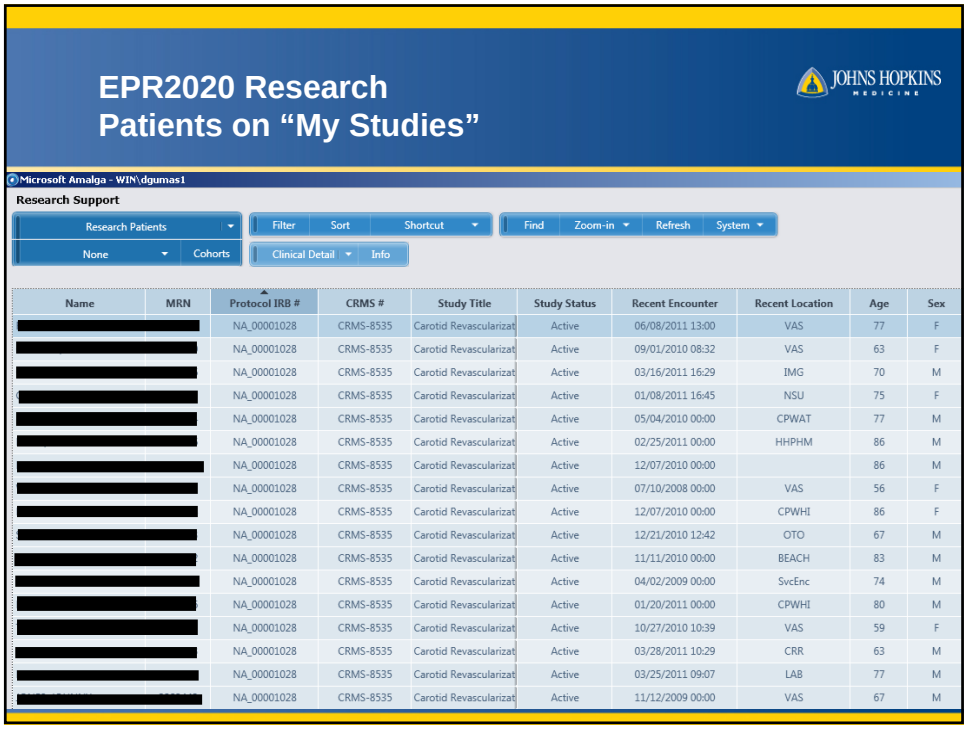
5

2. EPR2020 Clinical Data Repository



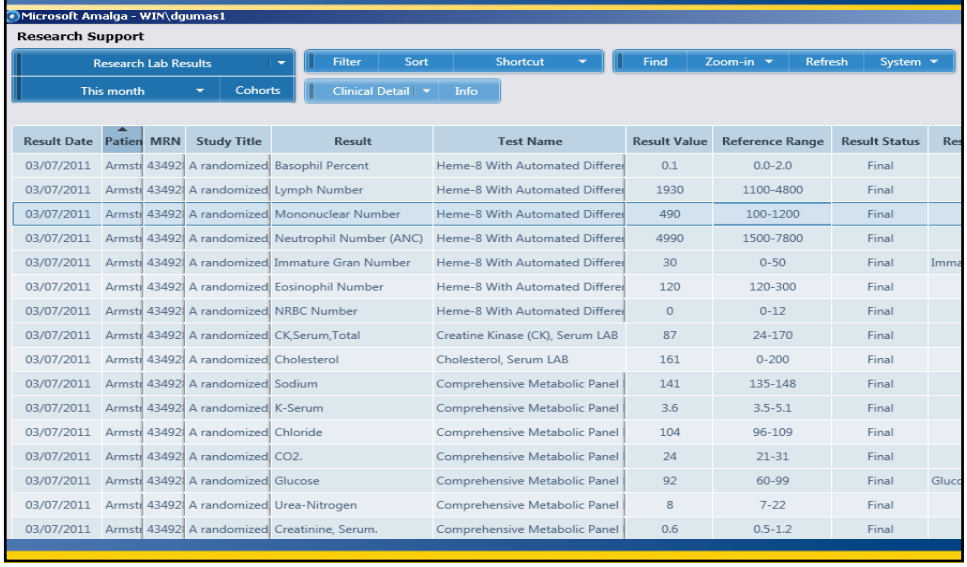
6

EPR2020 Research Patients on "My Studies"



Name	MRN	Protocol IRB #	CRMS #	Study Title	Study Status	Recent Encounter	Recent Location	Age	Sex
[redacted]		NA_00001028	CRMS-8535	Carotid Revascularizat	Active	06/08/2011 13:00	VAS	77	F
[redacted]		NA_00001028	CRMS-8535	Carotid Revascularizat	Active	09/01/2010 08:32	VAS	63	F
[redacted]		NA_00001028	CRMS-8535	Carotid Revascularizat	Active	03/16/2011 16:29	IMG	70	M
[redacted]		NA_00001028	CRMS-8535	Carotid Revascularizat	Active	01/08/2011 16:45	NSU	75	F
[redacted]		NA_00001028	CRMS-8535	Carotid Revascularizat	Active	05/04/2010 00:00	CPWAT	77	M
[redacted]		NA_00001028	CRMS-8535	Carotid Revascularizat	Active	02/25/2011 00:00	HHPHM	86	M
[redacted]		NA_00001028	CRMS-8535	Carotid Revascularizat	Active	12/07/2010 00:00		86	M
[redacted]		NA_00001028	CRMS-8535	Carotid Revascularizat	Active	07/10/2008 00:00	VAS	56	F
[redacted]		NA_00001028	CRMS-8535	Carotid Revascularizat	Active	12/07/2010 00:00	CPWHI	86	F
[redacted]		NA_00001028	CRMS-8535	Carotid Revascularizat	Active	12/21/2010 12:42	OTO	67	M
[redacted]		NA_00001028	CRMS-8535	Carotid Revascularizat	Active	11/11/2010 00:00	BEACH	83	M
[redacted]		NA_00001028	CRMS-8535	Carotid Revascularizat	Active	04/02/2009 00:00	SvcEnc	74	M
[redacted]		NA_00001028	CRMS-8535	Carotid Revascularizat	Active	01/20/2011 00:00	CPWHI	80	M
[redacted]		NA_00001028	CRMS-8535	Carotid Revascularizat	Active	10/27/2010 10:39	VAS	59	F
[redacted]		NA_00001028	CRMS-8535	Carotid Revascularizat	Active	03/28/2011 10:29	CRR	63	M
[redacted]		NA_00001028	CRMS-8535	Carotid Revascularizat	Active	03/25/2011 09:07	LAB	77	M
[redacted]		NA_00001028	CRMS-8535	Carotid Revascularizat	Active	11/12/2009 00:00	VAS	67	M

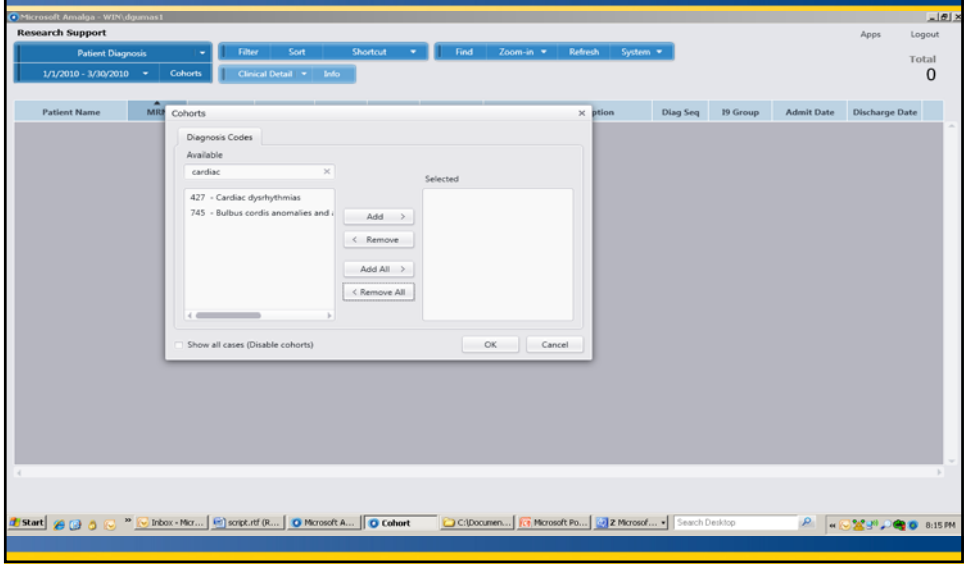
EPR2020 Research Lab Results View (Exportable!)



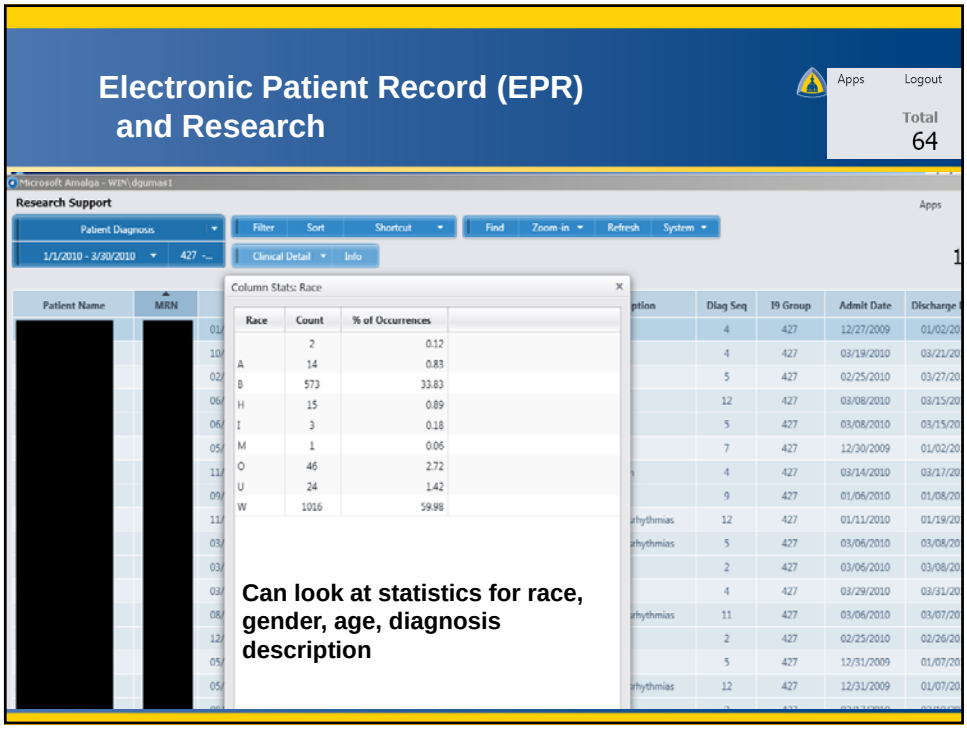
Result Date	Patien	MRN	Study Title	Result	Test Name	Result Value	Reference Range	Result Status	Re
03/07/2011	Armstr	43492	A randomized	Basophil Percent	Heme-8 With Automated Differe	0.1	0.0-2.0	Final	
03/07/2011	Armstr	43492	A randomized	Lymph Number	Heme-8 With Automated Differe	1930	1100-4800	Final	
03/07/2011	Armstr	43492	A randomized	Mononuclear Number	Heme-8 With Automated Differe	490	100-1200	Final	
03/07/2011	Armstr	43492	A randomized	Neutrophil Number (ANC)	Heme-8 With Automated Differe	4990	1500-7800	Final	
03/07/2011	Armstr	43492	A randomized	Immature Gran Number	Heme-8 With Automated Differe	30	0-50	Final	Imma
03/07/2011	Armstr	43492	A randomized	Eosinophil Number	Heme-8 With Automated Differe	120	120-300	Final	
03/07/2011	Armstr	43492	A randomized	NRBC Number	Heme-8 With Automated Differe	0	0-12	Final	
03/07/2011	Armstr	43492	A randomized	CK,Serum,Total	Creatine Kinase (CK), Serum LAB	87	24-170	Final	
03/07/2011	Armstr	43492	A randomized	Cholesterol	Cholesterol, Serum LAB	161	0-200	Final	
03/07/2011	Armstr	43492	A randomized	Sodium	Comprehensive Metabolic Panel	141	135-148	Final	
03/07/2011	Armstr	43492	A randomized	K-Serum	Comprehensive Metabolic Panel	3.6	3.5-5.1	Final	
03/07/2011	Armstr	43492	A randomized	Chloride	Comprehensive Metabolic Panel	104	96-109	Final	
03/07/2011	Armstr	43492	A randomized	CO2.	Comprehensive Metabolic Panel	24	21-31	Final	
03/07/2011	Armstr	43492	A randomized	Glucose	Comprehensive Metabolic Panel	92	60-99	Final	Gluc
03/07/2011	Armstr	43492	A randomized	Urea-Nitrogen	Comprehensive Metabolic Panel	8	7-22	Final	
03/07/2011	Armstr	43492	A randomized	Creatinine, Serum.	Comprehensive Metabolic Panel	0.6	0.5-1.2	Final	

Researcher App View: Diagnosis

"Find my patients who had a cardiac diagnosis in the 1st quarter of 2010"

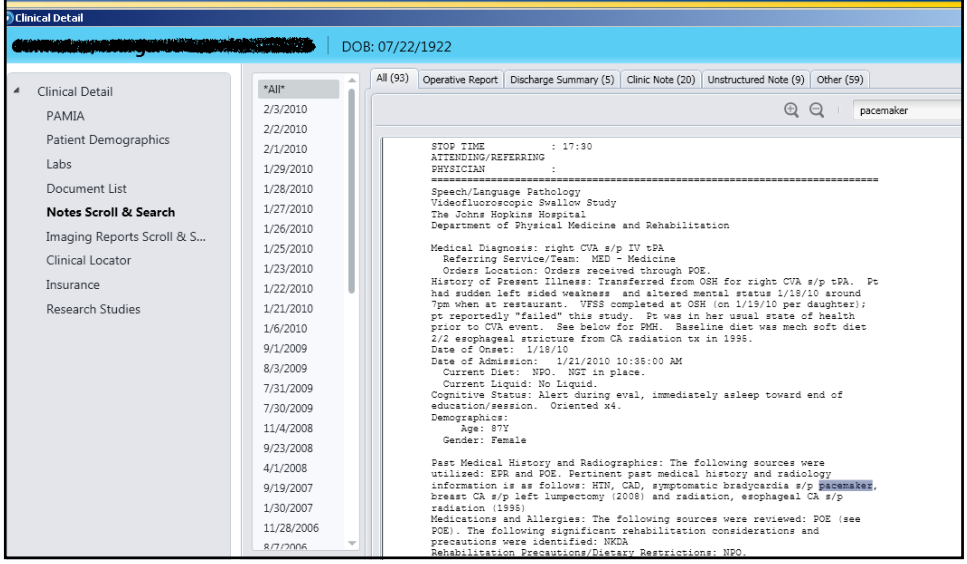


Electronic Patient Record (EPR) and Research



Can look at statistics for race, gender, age, diagnosis description

EPR2020 Search patient's documents for key term



For Access to EPR2020 Contact:

Diana Gumas: dgumas1@jhmi.edu

12

3. Center for Clinical Data Analysis (CCDA)

Provides periodic (monthly/quarterly) bulk data extracts

- **Preliminary, anonymous data** for feasibility, grant applications and statistical sample-size estimates
- **IRB-approved case-finding**--for study enrollment (mailings, phone solicitation), chart review, and cohort/case-control studies
- **Research data extracts** - monthly/quarterly integrated extracts from EPR, POE, ORMIS, lab/PDS, billing systems, vaccination/transfusion/culture data, etc.

13

How CCDA works

For IRB-approved research:

- Provide full protocol + IRB approval
- Meet to discuss query methods, format
- Iterate, then schedule production (email extracts, Jshare)
- Hourly cost

For non-IRB projects (exploratory analyses, QI)

- Same process, cost subsidized by ICTR/JHM (?)
- Do NOT implicitly morph QI into IRB

For more information, contact:
David Thiemann - dthiema1@jhmi.edu

14

Structuring a data request

JOHNS HOPKINS MEDICINE

Who?	List of MRNs or cohort defined by characteristics?	
What?	Procedures? PCP encounter? Diagnosis? Free Text? Lab results?	Repeat: Procedures? Diagnosis? Free Text Search? Lab results?
When?	Age of individual? Date/range of event?	Does another thing happen in a certain time frame?
Where?	Zip code? Unit? Floor? Hospital? PCP location?	**Structuring your data request clarifies your thinking and improves communication with the data analyst**
Why or How?		

15

Data Sources

JOHNS HOPKINS MEDICINE

- EMR Data
- Financial Data
- Registry Data
- State / National / Public data sets
- Research study data sets

JHM has a great deal of data:

- It is structured for source production systems
- Challenging to data mine
- Very difficult to join across systems.
- Inappropriate access can lead to significant legal implications

16

Johns Hopkins Medicine Clinical Systems Environment

	JHH	JHBMC	HCGH	Suburban	JHCP	
Patient Portal	EPIC MyChart	EPIC MyChart	EPIC MyChart	EPIC MyChart	EPIC MyChart	Health Information Exchange (CRISP)
Registration / Scheduling	EPIC	Meditech / Epic, GE (IDX)	Meditech	McKesson	GE (IDX)	
ADT	Keane	Meditech	Meditech	McKesson		
Inpatient EMR	Allscripts	Meditech	Meditech	McKesson		
Ambulatory EMR	EPIC	EPIC	EPIC	EPIC	EPIC	
Specialties	Varied	Varied	Varied			
EPR2020	Enterprise Clinical Data and Document repository					
Hospital Billing	Keane	Meditech	Meditech			
Professional Billing	GE (IDX)	GE (IDX)	GE (IDX)	GE (IDX)	GE (IDX)	

17

JHM Data Source Systems

System	Contact	Notes
EPR2020 / EPR	CCDA Diana Gumas David Thiemann	Some search functionality. Integration with CRMS. Data mining is SQL based hand work. Tables are very complex and require domain expertise. Usually requires an IRB request and funding source.
Allscripts (SCM)	CCDA Marty Hamburg	Data mining is SQL based hand work. Tables are very complex and require domain expertise. Usually requires an IRB request and funding source.
Meditech	Andy Frake	Reporting capability
Epic	Jim Ham	TBD process, outpatient and Community Division data
Casemix	David Plaut	Billing data, requires access permissions, some standard reports
Speciality	System Owner	ORMS, Metavision, TheraDoc, EBB, etc
I2b2	Sam Meiselman	Counts, deidentified data, pre-IRB

18

Types of data

- Clinical Data – Labs, Radiology, Clinical Documentation
- Casemix
- Billing - what items were charged to the patient, quantity, charge $(not cost), date and location at time of charge
- Payment data - $ paid against a bill by a paper, not the $ paid per item on the bill
- Costs (limited) – what did an item cost vs what we charged
- Pharmacy dispensing and adminstration detail (JHH only)
- Census & transfers (where are patients)
- Readmissions
- Outpatient Scheduling

19

Coding schemes

Code Type	Inpatient or Outpatient
ICD-9 Diagnosis	In & Out
ICD-9 Procedures	In
CPT	Out
MS DRG	In
APR DRG	In
CPC DRG (Charge/Case, MD only)	In
APG	Out
CPV APG (Charge/Visit, MD Only)	Out
RPC (charge item catalog)	In & Out
ICD- 10 coming soon…..	

July 22, 2013

20

Financial vs. Clinical data

- All coding schemes are financially driven
- There may be a diagnosis code for a disease that the patient does not actually have, however, resources were expended to rule that diagnosis out.
- Coding is driven by physician documentation

21

Challenges

- Silos of Data implemented over time
- Enterprise systems
  - EPIC
  - EPR / EPR 2020
  - Allscripts (Sunrise Clinical Documentation)
  - HMED (Emergency Room)
  - ORMIS (GE Centricity Periop Manager)
  - MetaVision (Anesthesia Documentation)
  - Casemix / Datamart / HDM
  - Theradoc
  - Electronic Bed Board (EBB)
  - OB Documentation (GE Centricity Perinatal)
  - Labs, Radiology and Pharmacy source system
- Patient case identification and matching between systems

22

Some Lessons Learned

JOHNS HOPKINS MEDICINE

Data Mining

1. **Must have strong clinical leadership and pervasive buy-in for research project**
2. **Must understand clinical workflow and source documentation to translate to the research study**
3. **Must stay within scope of readily known data**
4. **Must audit for completeness and accuracy**
5. **Retrospective Data – Important Caveats**

Data Dictionary / Version Control

Documentation Consistency over time and source systems

Documentation Purpose (Billing vs Clinical Documentation)

Discovery of new diagnosis – recoding historical data

Clinical Relevance and Intrepretation (time series data, lab and medication data)

JOHNS HOPKINS MEDICINE CARDIAC SURGERY

Other Internal Sources for Research Data

JOHNS HOPKINS MEDICINE

National Registries

Maryland Trauma Registry
Tumor Registry
UNOS Registry (Transplants)
NSQIP
VQI – Vascular Quality Initiative

Specialty Research Databases

School of Medicine
School of Public Health
Kennedy Kreiger Institute

National CV Registries

STS Adult Cardiac Surgery
STS Congenital Cardiac Surgery Registry
STS Thoracic Registry
STS Cardiac Anesthesia Registry
STS/ACC TVT Registry

INTERMACS VAD Registry
PEDIMACS VAD Registry
ELSO Registry (ECLS Registry)
PC4 Registry (Pediatric Cardiac Critical Care)

ACC NCDR Action Registry -GWTG
ACC NCDR IMPACT (Ped & Adult Congenital)
ACC ICD (Generator & Leads)
ACC Cath PCI Registry

JOHNS HOPKINS MEDICINE DEPARTMENT OF SURGERY

Data Registries and Internal Database Initiatives

What will Epic do for researchers?

- Research Encounter Scheduling
- Better Research Billing
- Electronic research orders/preference lists
- Other studies for which your patient is a participant
- Report that patient admitted or arrived at ED
- Data querying tools accessible by Epic user
- Patient Reported Outcomes via MyChart patient portal
- Registries from data collected in Epic
- Access to codified data across the enterprise

26

Epic Data

- Ambulatory, HCGH, Sibley are on-line
- Some historical data migrated to Epic. TBD research utility
- JHBMC and JHH remain with legacy systems for near term future
- Challenge will be to join inpatient and Epic-data
- Data access for researchers discussions are underway
- Several proposed points of access:
  - Department based – TBD readiness
  - I2b2 – pilot available now http://i2b2.johnshopkins.edu/
  - Center for Clinical Data Analysis
  - Epic reporting team – TBD readiness

How will researchers get access to Epic data for research?

Still under discussion…

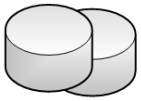
Likely to be services provided by CCDA

28

Clinical Data Environment

JOHNS HOPKINS MEDICINE

Legacy Data
- JHH
- JHBMC



Opportunities
- Detailed inpatient data
- Medications
- Readmission notification
- Practice variation

Risks
- Not integrated
- Transitions of care

Care data – Challenging to access

Epic Ambulatory Data

Opportunities
- Registries for Chronic Disease and Wellness
- Tools for clinicians, PCP staff, and care coordinators
- Data via Clarity export

Risks

Epic Community Division Data

Opportunities
- Inpatient, Meds and ED visits available for care management
- Readmission alert
- Practice variation
- Data via Clarity export

Risks

Care data – accessible via Epic

JHHC Systems ACO-like

Opportunities
- Care coordination
- Management of Risk
- "what if" analysis
- ACO reporting
- How are we doing?
- New business

Additional Data
- CAHPS / HCAHPS
- CMS data sets
- 3rd party or pilot data sets-- ie High Value Health Collaborative
- CRISP?
- Epic extensions to non JHM practices and hospitals

EMR Data – Chronic Disease – Planned Business Objects Universes

JOHNS HOPKINS MEDICINE

Diabetes		Chronic Disease Management	
Snapshot Date - Diabetes		Diabetes	
Alcohol & Tobacco Use - Diabetes		Diabetes	
Comorbidities - Diabetes		Diabetes	
Numeric - Comorbidities - Diabetes		Comorbidities - Diabetes	
Immunizations - Diabetes		Diabetes	
Medications - Diabetes		Diabetes	
Numeric - Diabetes		Medications - Diabetes	
Most Recent Labs - Diabetes		Diabetes	
Pregnancy - Diabetes		Diabetes	
Visit History - Diabetes		Diabetes	
Vitals - Diabetes		Diabetes	

628 Objects / 47 tables / 1528 Rows across CHF, Diabetes, Hypertension Registries

Epic will be a phenomenal tool, and . . .
- **Set up required:** We need to check for Clarity, BOE, and future Data Warehouse connections between tables
- **Alignment:** We need to align our data access policies with JHM-available tools
- **Deidentified Access:** I2b2 can act as a interim bridge to access deidentified Epic data if interface connections are approved
- **Interim Data Warehouse:** I2b2 is currently acting as a synthetic data warehouse until the Epic EDW is funded and brought on line.

And finally, some wise words
from Dr. David Thiemann

JOHNS HOPKINS MEDICINE

- Real work, not ad hoc/bootstrap
- Need $$$ and FTE(s)
- Smart analyst(s) who know database technology and understand (or can learn) nuances of the sources and content domain
- Hands-on PI management/guidance
- Statistical liaison early, before database schema and ETL methods are set in stone

31

The Extract-Transform-Load process: Getting Clinical Data into Research DB

JOHNS HOPKINS MEDICINE

- Raw clinical/administrative data is limited and must be used with caution in research
- Build an intermediate (staging) database
  - Don't do data management in SAS/Stata/Excel
- Data dictionary—derivation for each field
- Templated, tested, documented cleanup scripts/routines.
- Intermediate tables: Log each step/modification
  - For each batch, be able to re-create data transform from scratch
  - Version control, change control and documentation are vital
  - Build data versioning into the database

32

Transforming Data is Non-Trivial

JOHNS HOPKINS MEDICINE

- **Raw data typically string (char/text) fields**
- **Unanalyzable characters (* < >, comments) still have meaning**
  - Put non-numeric data in separate field. Avoid numerical recoding (999)
- **~3% of pts have multiple/non-preferred MRNs**
  - Need 1-to-many link table
- **Assays/reference ranges/coding changes**
  - Avoid using raw codes (CPT/ICD) in research db
  - Map clinical codes to research terms
- **Defer analytic assumptions. When recoding data, anticipate problems. Keep options open.**

33

Understanding Business Logic

JOHNS HOPKINS MEDICINE

Trust but verify: Test coding accuracy

- Providers may habitually use imprecise/inaccurate diagnosis codes (especially in profee data)
- ICD9 procedure indications often a billing fiction
- Trained coders may make systematic errors
- Different content domains may have different standards (inpt vs outpt coders)
- Don't infer/assume dependencies unless enforced by source system.

Run min/max queries, aggregates, outer joins

- Confirm date ranges, data ranges, relative proportions by year
- For ex. Lab results on deceased patients may be legitimate

Don't assume that null rows actually are empty. Maybe the query missed something.

34

4. caTissue for Collecting & Accessing Biospecimen Data

What caTissue can do for you

- Track collection and storage of specimens
- Clinical annotations
- Track distribution of specimens
- Derivation and Aliquotting of specimens
- Reports

Cost

- No Charge for respositories using basic services
- Hourly charge for legacy data migration, special reports & features

For more information: Diana Gumas dgumas1@jhmi.edu

35

i2b2 BackGround

www.i2b2.org

- Informatics for Integrating Biology & the Bedside
- Simple Tool Yielding Accelerated Data Access
- Deidentified Cohort Builder
- Query “Articulator”

I2b2

I2b2 pilot is a proven path –

- https://www.i2b2.org/
- Cohort Finding Tool
- Some basic data visualization tools
- Flexible and simple Data Mart Schema
- Customizable Ontologies
- **Many open source additional modules**
- **SHRINE as a possible link to non-JHM institution data sets**

Shorten cycle time from idea to data for analysis

Self Service + Collaboration

i2b2 at JHMI

Landing Page http://i2b2.johnshopkins.edu/

- Request Access
- Client Launch
- System Information and Announcements
- Help Documentation and Support Links

i2b2 at JHMI

Architecture
- Database
  - Fed from JHMI Source Systems
    - EPR2020
    - SCM
  - Deidentified for i2b2 Users
  - Re-"identifiable" for DBAs
- Web Application
  - JHED authorized security
  - Web application is only way for Users to access data

i2b2 at JHMI Data Content

Dimensions
- Patients/ Demographics
- Visits/ Encounters
- Providers

"Facts" (clinical findings)
- Numeric Labs
- Inpatient and Outpatient Diagnosis*
- Inpatient Procedures
- Inpatient Medications (in progress)

I2B2 inventory

Data	Status	Q	Notes
Patient Mapping and Dimension	Completed	2.5M	Patients and visits based on EPR2020 identity backbone Including multi-institution and multi-MRN references.
Visit mapping and dimension	Completed	42M	Needs validation of inpatient v. outpatient flags
Provider dim.	Completed	0.35M	Contents of EPR/EPR2020 (CDT provider)
Provider Ontology	In progress		JHH and Bayview providers
Demographics	Completed	2.5M	Includes: Age, zipcode, race, gender
Diagnosis	Completed	40M	Based on ICD9 codes from datamart and IDX via EPR2020. Some gaps identified
Inpatient Procedures	Completed	2M	Based on ICD9 codes from datamart and IDX via EPR2020.
Outpatient Procedures	In Progress		Requires a CPT lookup table and procedure fact records
Lab Data	In Progress	3Years	Ontology and Numeric results complete. Standard Text results, complex test results in progress
Meds	In Progress	TBD	Dispensed meds from SCM (JHH only for now). Current plan is to use Multim ontology until rxNorm can be added.

i2b2 at JHMI

Category	Record Count
Clinical Findings (lab, diagnosis etc)	196156286
Inpatient and Outpatient Visits	45329952
Patients	4781047
Providers	35073
Ontology Concepts	29689

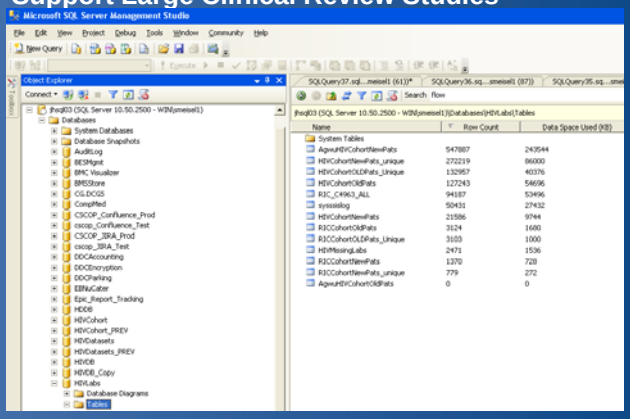
i2b2 and CCDA

Customer Self Service via i2b2
- – Feasibility
- – Query Articulation

CCDA Extracts/ Data Support Extend Reach
- – Ongoing or One Time Extracts
- – Variety of Outputs
- – Process of Intake, Requirements, Development

Case Studies

- **Richard Moore HIV Studies**
  - **Ongoing Database Extracts**
  - **Support Large Clinical Review Studies**

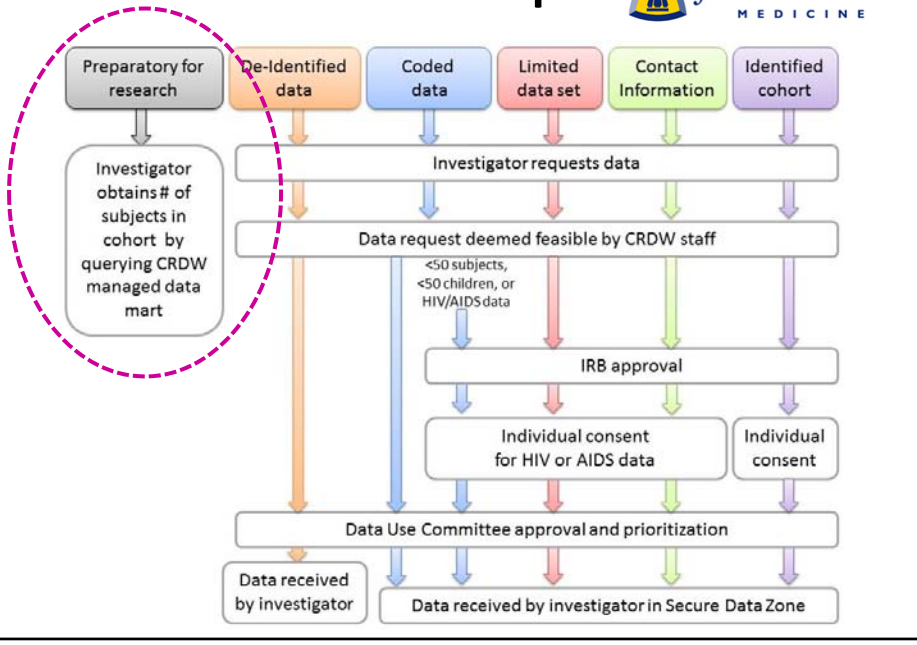


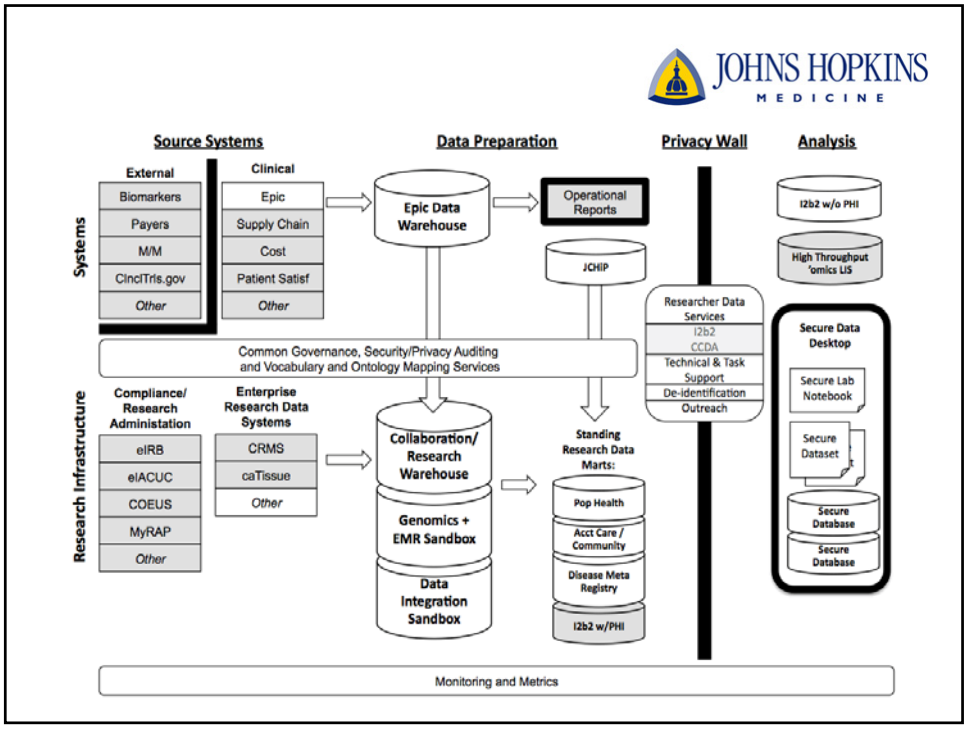
S. Melzer ACS Review: Barrett's Esophagus

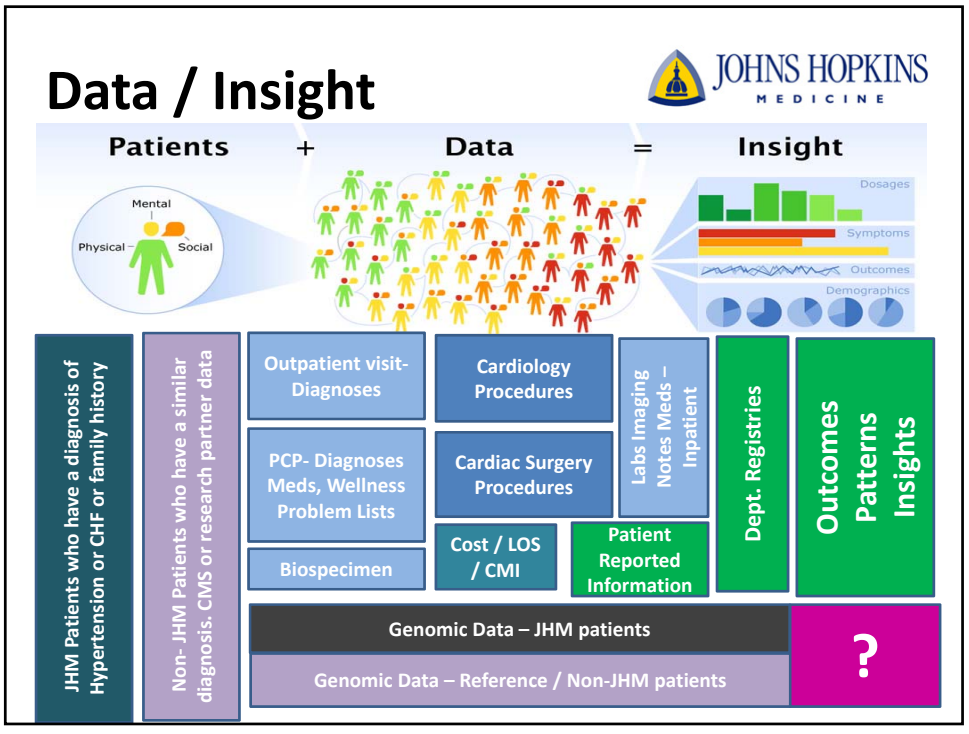
- 4.4 M patients and 26M visits
- 12.8 M documents / 7.2 M Radiology Reports
- 28M Lab Results

		Pathology Report Findings													
		Adeno CA		BE-HGD		BE-IND		BE-LGD		BE-ND		NORMAL		SQ-CA	
Diag Group	Pt Count	Pts	Events	Pts	Events	Pts	Events	Pts	Events	Pts	Events	Pts	Events	Pts	Events
All Diagnoses	7752	2503	2802	722	1323	573	1070	618	1230	223	250	3515	3442	591	869
Barrett esophagus (530.85)	4558	1114	1575	512	1087	514	1004	514	1109	188	220	2580	2929	105	180
Barrett in EPR Problem List	1833	770	1201	237	514	139	387	181	443	83	92	876	1633	172	283
Malignant neoplasm of abdominal esophagus (150.2)	52	17	22	4	8	0	0	3	4	0	0	15	44	2	3
Malignant neoplasm of esophagus (150)	2863	1452	1990	419	812	120	299	238	532	56	79	949	1551	47	67
Malignant neoplasm of esophagus unspecified site (150.9)	2348	1247	1694	348	688	104	277	202	471	49	70	830	1418	37	55
Malignant neoplasm of lower third of esophagus (150.5)	782	535	1000	197	415	61	155	109	274	22	31	300	626	9	7
Malignant neoplasm of middle third of esophagus (150.4)	189	53	97	15	33	4	33	16	47	3	4	62	101	9	0
Malignant neoplasm of other specified part of esophagus (150.8)	719	425	803	134	283	36	123	76	205	15	19	310	541	14	7
Malignant neoplasm of thoracic esophagus (150.1)	76	32	67	17	34	3	3	12	15	0	0	30	36	3	0
Malignant neoplasm of upper third of esophagus (150.3)	146	64	129	18	29	3	12	12	27	2	2	56	98	5	4

Access – Future Concept




JOHNS HOPKINS MEDICINE
Source Systems
Data Preparation
Privacy Wall
Analysis
Systems
External
Biomarkers
Payers
M/M
ClinicalTrls.gov
Other
Clinical
Epic
Supply Chain
Cost
Patient Satisf
Other
Epic Data Warehouse
Operational Reports
JCHIP
I2b2 w/o PHI
High Throughput 'omics LIS
Researcher Data Services
I2b2
CCDA
Technical & Task Support
De-identification
Outreach
Secure Data Desktop
Secure Lab Notebook
Secure Dataset
Secure Database
Secure Database
Common Governance, Security/Privacy Auditing and Vocabulary and Ontology Mapping Services
Research Infrastructure
Compliance/ Research Administation
eIRB
eIACUC
COEUS
MyRAP
Other
Enterprise Research Data Systems
CRMS
caTissue
Other
Collaboration/ Research Warehouse
Genomics + EMR Sandbox
Data Integration Sandbox
Standing Research Data Marts:
Pop Health
Acct Care / Community
Disease Meta Registry
I2b2 w/PHI
Monitoring and Metrics


Data / Insight
JOHNS HOPKINS MEDICINE
Patients
+
Data
=
Insight
Mental
Physical
Social
Dosages
Symptoms
Outcomes
Demographics
JHM Patients who have a diagnosis of Hypertension or CHF or family history
Non- JHM Patients who have a similar diagnosis. CMS or research partner data
Outpatient visit-Diagnoses
PCP- Diagnoses Meds, Wellness Problem Lists
Biospecimen
Cardiology Procedures
Cardiac Surgery Procedures
Cost / LOS / CMI
Labs Imaging Notes Meds – Inpatient
Patient Reported Information
Dept. Registries
Outcomes Patterns Insights
Genomic Data – JHM patients
Genomic Data – Reference / Non-JHM patients
?