

Enabling technologies for research using clinically acquired medical image data: Clinical Image Bank and MI2B2

Randy L. Gollub, MD, PhD

Departments of Psychiatry and Radiology, MGH

Professor, Harvard Medical School

Affiliate Faculty, Health Sciences and Technology, MIT



MASSACHUSETTS
GENERAL HOSPITAL



**Boston
Children's
Hospital**

Until every child is well™



THE
HARVARD
MEDICAL SCHOOL

Acknowledgements

RPDR

- Shawn N Murphy
- Christopher Herrick
- Mariah Mitchell
- Stacey Duey
- Laurie Bogosian
- Eugene Braunwald
- Anne Klibanski
- Henry Chueh



CIB

- Shawn N Murphy
- Randy L Gollub
- Vivian Gainer
- Andrew Cagan
- Nich Wattanasin
- Christopher Herrick
- Bill Wang
- Reeta Metta
- Rudolph Pienaar
- Yangming Ou



Mi2b2

- Randy L Gollub
- Shawn N Murphy
- Christopher Herrick
- Bill Wang
- David Wang
- Kathy Andriole
- Darren Sack
- P Ellen Grant
- Nathaniel Reynolds
- Kallirroi Retzepe
- Rudolph Pienaar
- Victor Castro
- Steve Pieper
- Lilla Zollei
- Yangming Ou

Partners Healthcare, NIH/NCBC; /NIMH; /NCBI; /NCATS; /NIBIB
NIH RO1 EB014947
NIH R01 AT006364
NIH R01 AT005280
NIH P01 AT006663

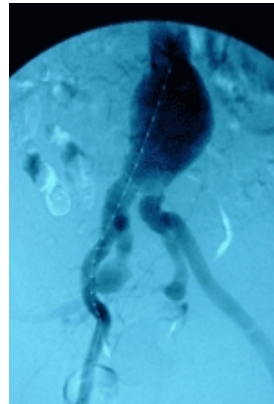
Medical Imaging in EHR



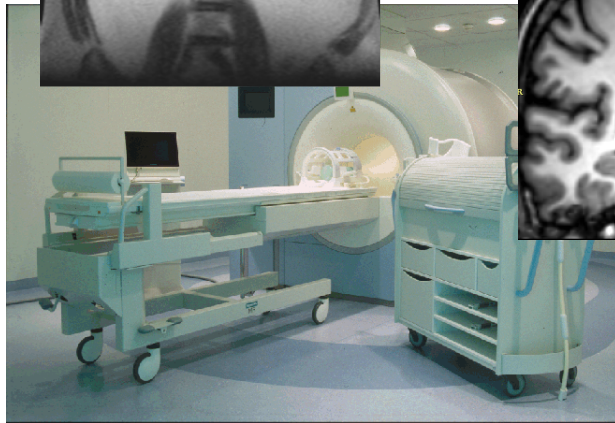
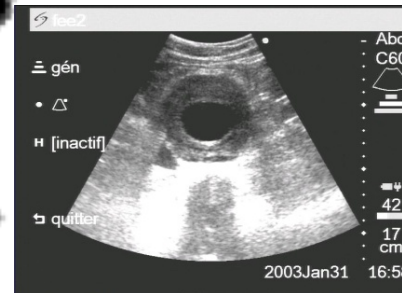
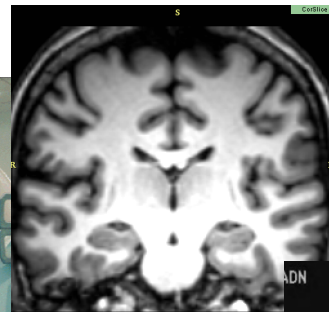
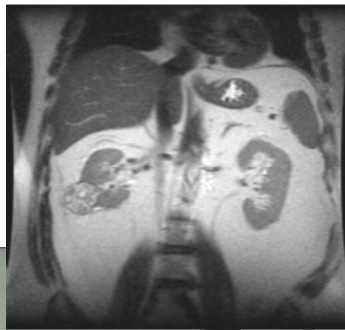
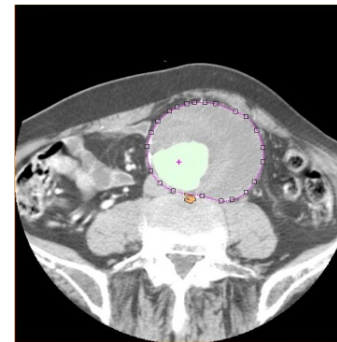
Radiology Report (NLP-able)



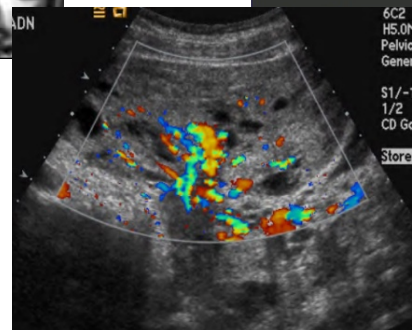
Order for imaging



Order for imaging



Billing for image acquisition



Billing for image interpretation
Billing for image processing

Research \neq Clinical

Research	Clinical
Common acquisition protocol	Customized per-patient
Controlled context and data curation	Wide variability
Highest reasonable image resolution	Best clinically justified images
Coverage of target structures	Only what is needed to answer the question at hand
Acquisition often custom for research software	Acquisition paired with commercial workstation features
Often normal subjects	Almost never normal (pathology and other variability)
Quantitative	Qualitative



Advancing High-Value Imaging to Support Patient Care and Research

DECEMBER 22, 2016 AT 10:30 AM ET BY RODERIC PETTIGREW, RICHARD CAVANAGH, JERRY SHEEHAN, AND MICHAEL CHEETHAM

	Referral	Scan	Interpretation	Next Steps
Current Practice	Driven by professional habit, time pressure, defensive medicine, networks	Lengthy techniques or imaging series	Qualitative: much information is discarded	Further imaging or consultation
Future Possibility	Driven by evidence-based Appropriate Use Criteria (AUC)	Faster, high-value techniques with shorter targeted protocols	Quantitative assessments: analytical tools mine image data for more useful information	Reduced need for further imaging: more timely and precise diagnostics and treatment

And yet.....

H_0 : Clinically acquired images have tremendous potential to advance biomedical research as well as clinical care

Radiomics

“...high-throughput extraction of quantitative features that result in the conversion of images into mineable data and the subsequent analysis of these data for decision support...”

“...it is conceivable that conversion of [standard of care] digital images to mineable data will eventually become routine practice...”

- Gillies et al, Radiology 2016



Identify Subjects / Request Data

GET HELP

Enterprise-wide data services are available to help Partners investigators and research groups expedite the process of obtaining data for analysis or to gauge study feasibility. Repositories of clinical samples and data, as well as public data sets, are accessible to researchers through the tools and processes outlined below.

A new initiative, the Partners wide Big Data Commons, enables Big Data to be integrated with the RPDR and tighter integration of the RPDR with Epic. The specific areas of focus of the Big Data Commons are to create a Research Patient Portal for direct patient engagement in Epic, creating a distributed query system to allow more types of Partners Big Data to be integrated and become discoverable by researchers, and specific integration platforms such as the Biobank Portal which serve to researchers new forms of Big Data in easily consumable forms.

Partners Clinical Image Bank

Research Patient Data Registry

Research Patient Data Registry (RPDR)

RPDR Daily Query Tool

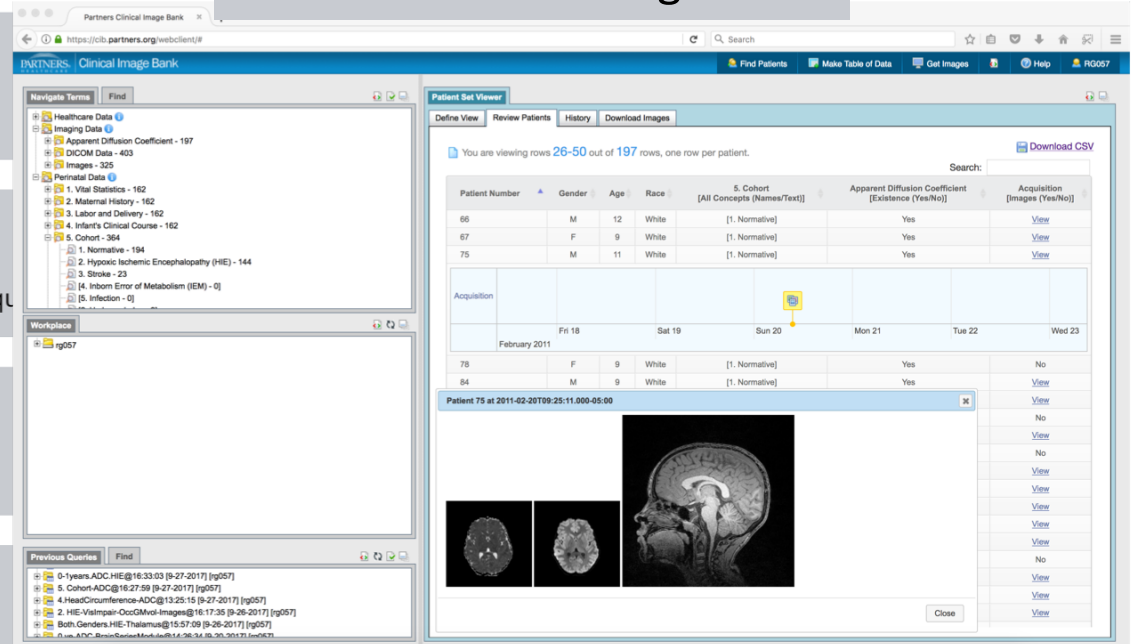
The RPDR has a new Daily Query Tool where users can query

Partners Biobank Portal

Biobank Portal

mi2B2 Medical Image Access Tool

mi2B2 Medical Image Access Tool





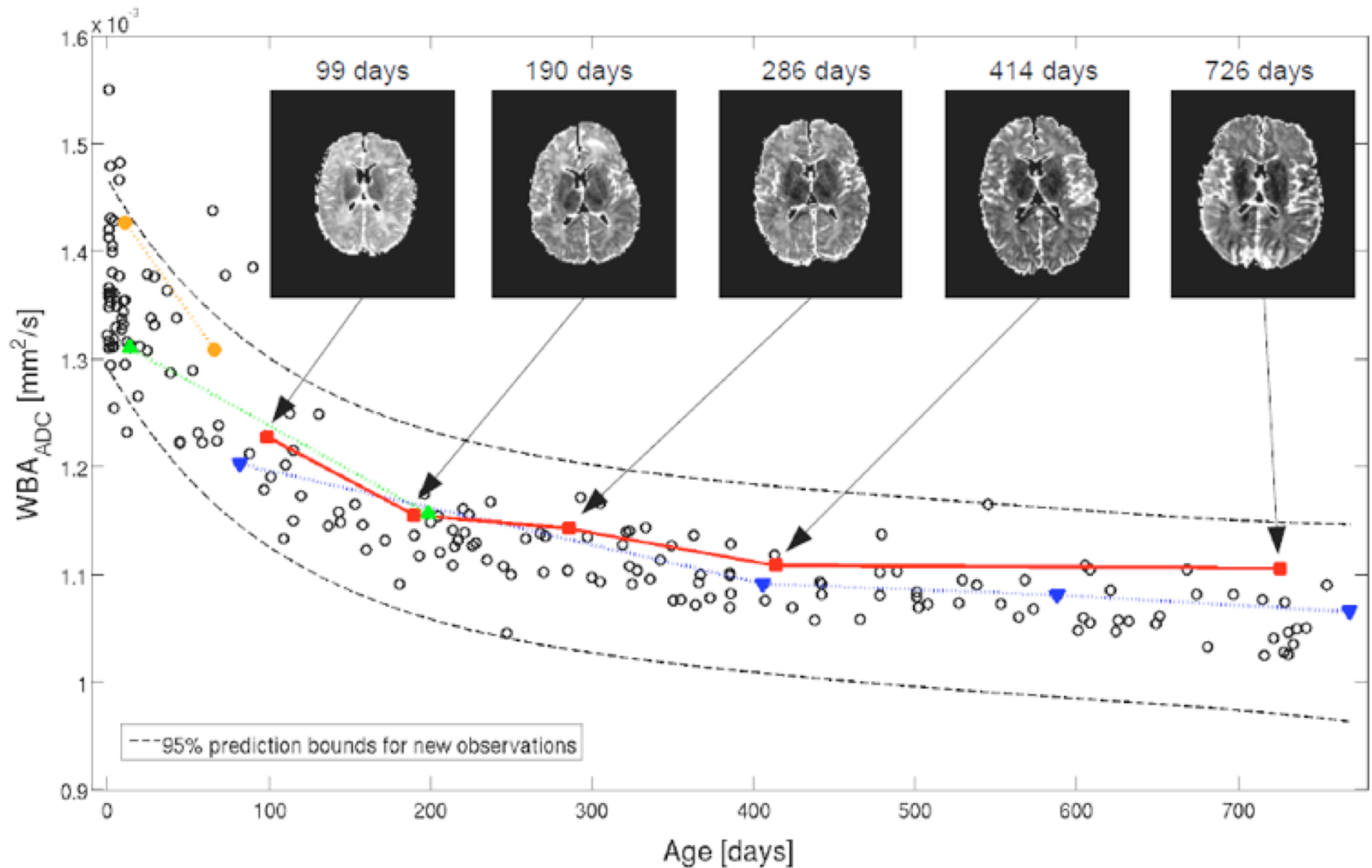
Amassing Pediatric Brain MRI's to Understand “Normal” using Mi2b2

P. Ellen Grant, Yangming Ou, Lilla Zollei, Rudolph Pienaar, Steve Pieper, Sara Bates, Shawn N. Murphy, Randy L. Gollub

Partners Healthcare System, Children's Hospital Boston,
and Massachusetts General Hospital, Boston, MA

Images Of Baby Brains: Priceless

- Whole-brain ADC from 100s of infants allow benchmarking



Using the Medical Imaging Informatics Bench to Bedside (mi2b2) Workbench

RPDR/i2b2 query

or

MRN list

Mi2b2 request

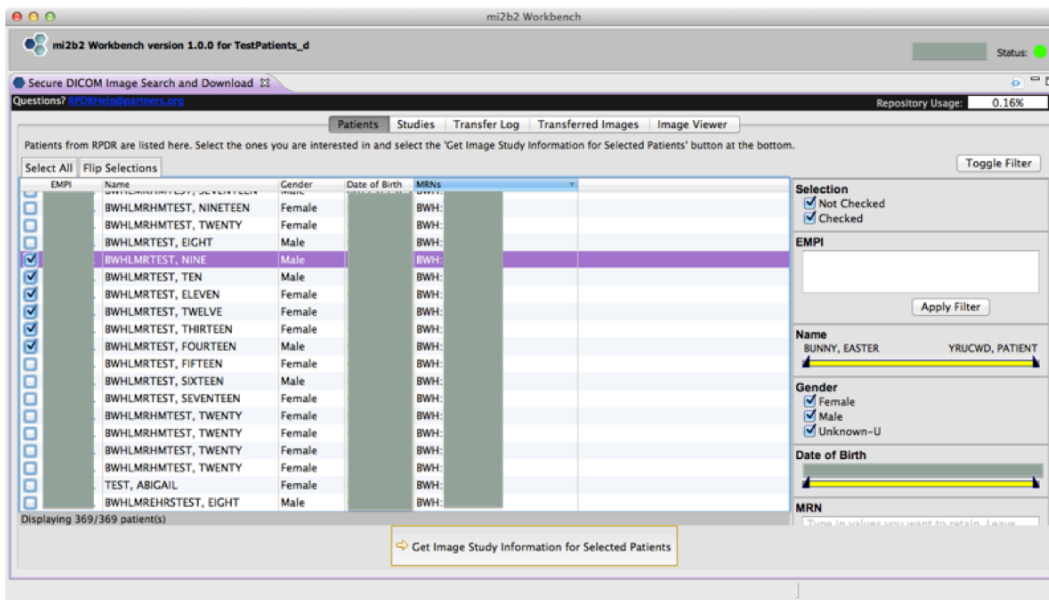
HIPAA compliant mi2b2 Workbench restricts access of investigator to the patient cohort identified in associated IRB, data pulls are audit logged

Download images

Murphy SN, Wang Y, Wang TD, Sack D, Reynolds N, Plesniak W, Andriole K, Wei J, Pieper S, Herrick C, Gollub RL. High throughput tools to access images from clinical archives for research, J Digit Imaging. 2015 Apr;28(2):194-204. doi: 10.1007/s10278-014-9733-9

Data Collection- RPDR + mi2b2

To get



Mi2b2 engine: <https://www.nmr.mgh.harvard.edu/lab/mi2b2>

Lead: Shawn Murphy, Randy Gollub (MGH) [Murphy et al, 2015]

To vet

N = ~100,000

- Brain MRI in MGH

N = 2,871

- Scanned 2006-2013 with ADC maps in Siemens 3T scanner
- 0-6 years old at the time of scan
- Radiological reports suggesting free of abnormality

N = 1,648

- ADC maps found and not corrupted

N = 705

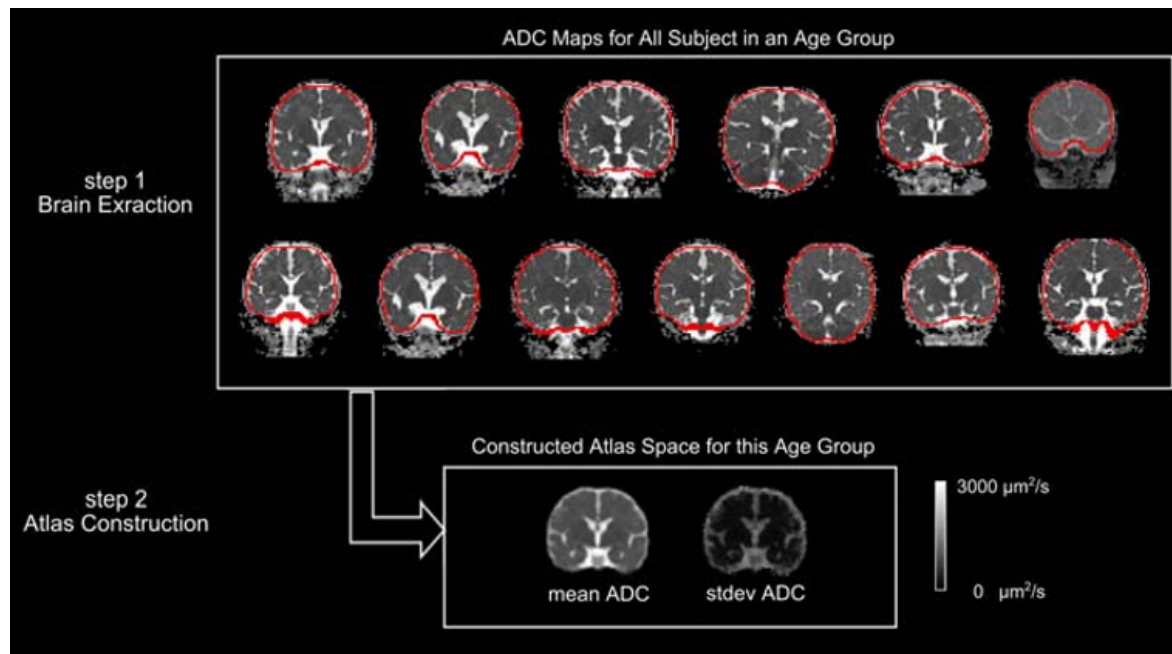
- ADC maps re-examined & confirmed to be normal by a neuro-radiologist (Dr. Grant) and a neonatologist (Dr. Bates)

N = 201

- Duplicates and CNS morbidity removed
- Still normal 3 years after the initial visit

Data Analysis Approach – Atlas Construction

Age	Y1					Y2	Y3	Y4	Y5	Y6	Total
	W1-2	Rest of Q1	Q2	Q3	Q4						
# Subjects	13	13	8	8	13	34	33	25	21	33	201
# Females	4	5	4	5	5	17	14	14	10	15	93



[Software for Atlas Construction]

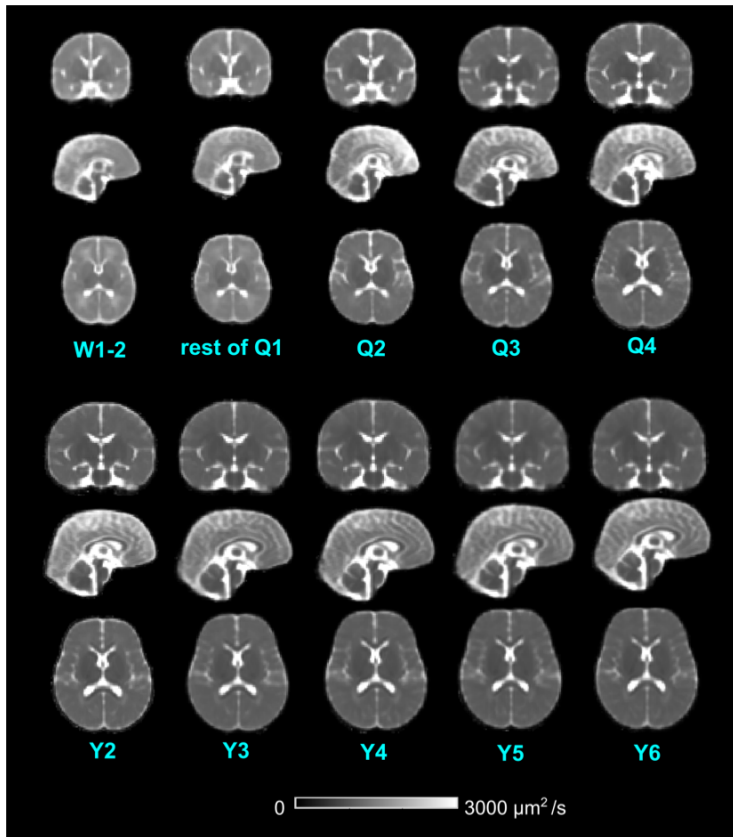
* Ou et al, <https://www.nitrc.org/projects/popdrumms>

[Atlases released]

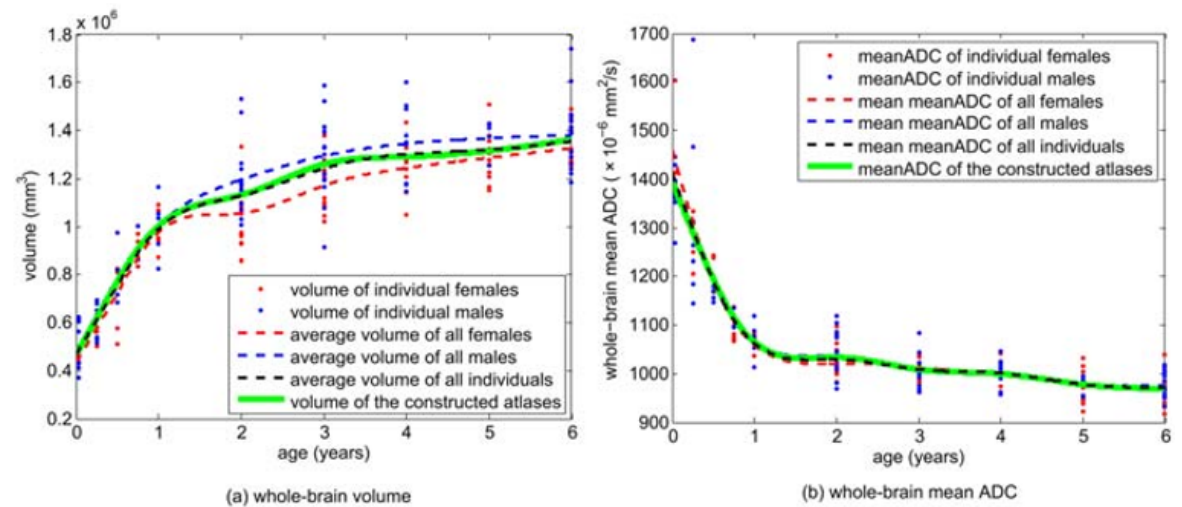
* Ou et al, https://www.nitrc.org/projects/mgh_adcatlases

Ou Y, Zollei L, Retzeppi K, Castro V, Bates SV, Pieper S, Andriole KP, Murphy SN, Gollub RL, Grant PE, Human Brain Mapping, 2017

Validation – are the atlases right?



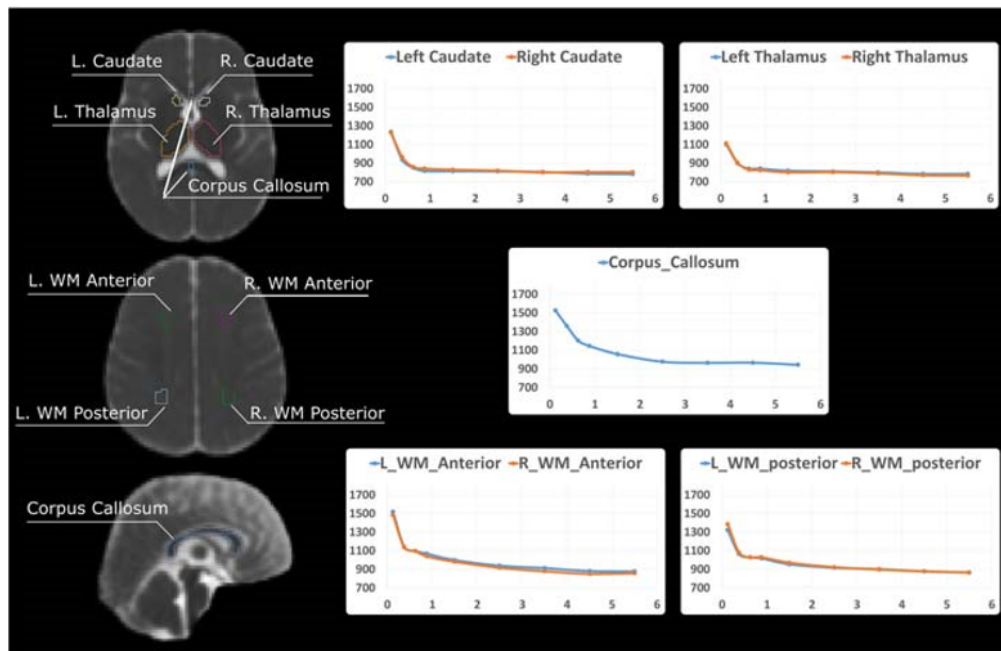
a) **Whole-brain** volume and ADC values, and changes



Statistically, at each age,
measurements from 1 atlas == measurements from multiple individuals

Validation – are the atlases right?

b) Regional and voxel-wise ADC values, and changes



measures from 1 atlas ~ measures from multiple individuals

	birth	Q1	Q2	Q3	Q4	Y2	Y3	Y4	Y5	Y6	20-40yo	Imaging protocol
Caudate												
Our atlases (L)		1235	936	848	814	812	810	804	786	781		Siemens 3T, 2x2x2 mm, b=1000
Our atlases (R)		1226	965	857	840	829	817	800	803	802		
Neil et al [6]	1240											Siemens 1.5T, 2x2x5mm, b=987/800
Sener et al [3]									820			Siemens 1.5T, b=1000
Thalamus												
Our atlases (L)		1101	899	840	840	818	809	799	783	782		Siemens 3T, 2x2x2 mm, b=1000
Our atlases (R)		1111	904	829	823	800	796	789	768	765		
Neil et al [6]	1080											Siemens 1.5T, 2x2x5mm, b=987/800
Sener et al [3]			980							830		Siemens 1.5T, b=1000
Helenius et al [24]											730	Siemens 1.5T, 2x2x5mm, b=1000
Naganawa et al [25]											830-910	Siemens 1.5T, 2x2x6mm, b=1000
Kwan et al [16]	1075	1020										Phillips 3T, 1.8x1.8x1.8mm, b=750
Corpus Callosum												
Our atlases		1524	1359	1204	1145	1057	976	963	960	942		Siemens 3T, 2x2x2 mm, b=1000
Morriss et al [20] (L genu)		1540		1310	1130	940	1080			869		Siemens 1.5T, 2x2x5mm, b=1000
Morriss et al [20] (R genu)		1470		1330	1320	950	1060			933		
Morriss et al [20] (L splenium)		1380		1410	1350	1180	1180			950		
Morriss et al [20] (R splenium)		1380		1240	1350	1030	1120			960		
Zhai et al [21] (genu)		~1200									~780	Siemens 3T, 1.72x5mm, b=1000
Zhai et al [21] (splenium)		~1150									~850	
Engelbrecht et al [8] (genu)		1280					760					Siemens 1.5T, 2x2x5mm, b=1000
Engelbrecht et al [8] (splenium)		1410					770					
Provenzale et al [74] (genu)						1180						GE 1.5T, 3x3x5mm, b=1000
Provenzale et al [74] (splenium)						1110						
Sadeghi et al [23]		~1350			~1050	~950						Siemens 3T, 2x2x2mm, b=1000
White Matter (Anterior)												
Our atlases (L)		1517	1142	1096	1037	998	938	911	880	875		Siemens 3T, 2x2x2 mm, b=1000
Our atlases (R)		1483	1137	1094	1039	980	915	877	850	856		
Neil et al [6]	1450											Siemens 1.5T, 2x2x5mm, b=987/800
Zhai et al [21]		~1500									~750	Siemens 3T, 1.72x5mm, b=1000
Engelbrecht et al [8]	1500						920					Siemens 1.5T, 2x2x5mm, b=1000
Helenius et al [24]											710	Siemens 1.5T, 2x2x5mm, b=1000
Naganawa et al [25]											780-860	Siemens 1.5T, 2x2x6mm, b=1000
Provenzale et al [74]			1330									GE 1.5T, 3x3x5mm, b=1000
Kwan et al [16]	1760	1508										Phillips 3T, 1.8x1.8x1.8mm, b=750
White Matter (Posterior)												
Our atlases (L)		1322	1064	1029	1017	952	915	900	876	865		Siemens 3T, 2x2x2 mm, b=1000
Our atlases (R)		1385	1081	1027	1028	970	921	896	877	863		
Neil et al [6]	1500											Siemens 1.5T, 2x2x5mm, b=987/800
Zhai et al [21]		~1550									~880	Siemens 3T, 1.72x5mm, b=1000
Engelbrecht et al [8]	1640						900					Siemens 1.5T, 2x2x5mm, b=1000
Helenius et al [24]											710	Siemens 1.5T, 2x2x5mm, b=1000
Kwan et al [16]	1494	1379										Phillips 3T, 1.8x1.8x1.8mm, b=750

Most common cause of Neonatal Brain Injury is Hypoxic Ischemic Encephalopathy (HIE)

- HIE occurs in 2-6/1000 infants, most common in term infants
- Therapeutic hypothermia is now the standard treatment
- Survivors often suffer from long-term neuro-cognitive deficits



Figure from cerebralpalsy.org

Standard of care includes brain MRI in first days of life. At MGH, state of the art, research quality acquisition protocol including DWI and quantitative ADC maps was established in 2008 and has been stable since.

Early MRI in term infants with perinatal hypoxic–ischaemic brain injury: Interobserver agreement and MRI predictors of outcome at 2 years

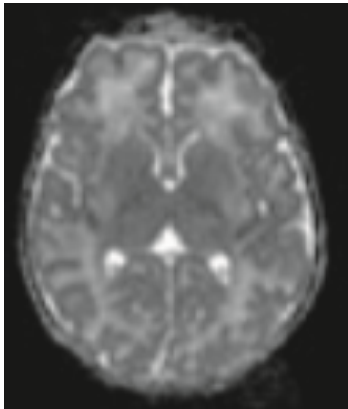
Goergen, et al, Clinical Radiology, 2014

Yet, 20-50% intra-/inter-rater variability or uncertainty even for experienced pediatric neuroradiologists!

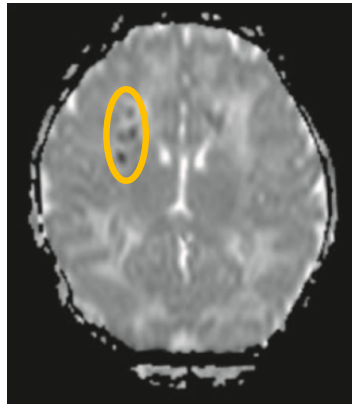
Detecting HIE Injury is difficult

- Gold Standard: Apparent Diffusion Coefficient (ADC) maps
- Abnormally low ADC values => restricted diffusion => lack of oxygen/blood
- **Q: How low is too low? What is within normal variation?**

An easy case



Gano et al, Ped. Res., 2012



De Veris et al, BMJ, 2010

More challenging cases

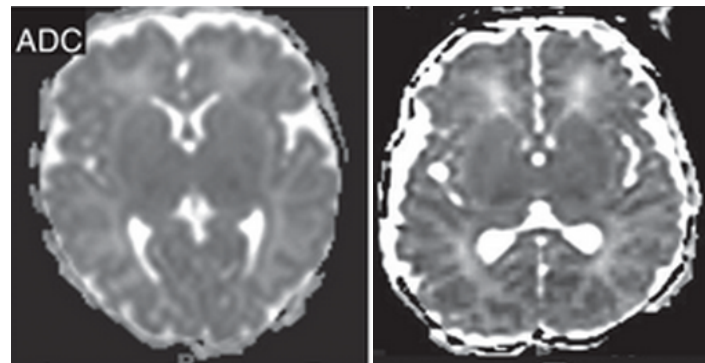
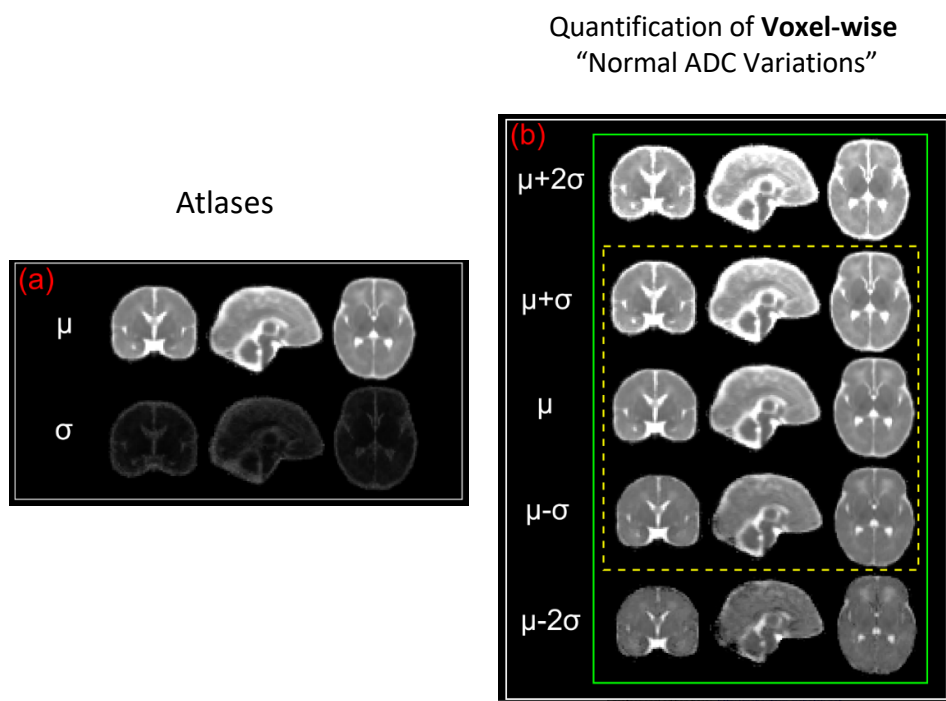


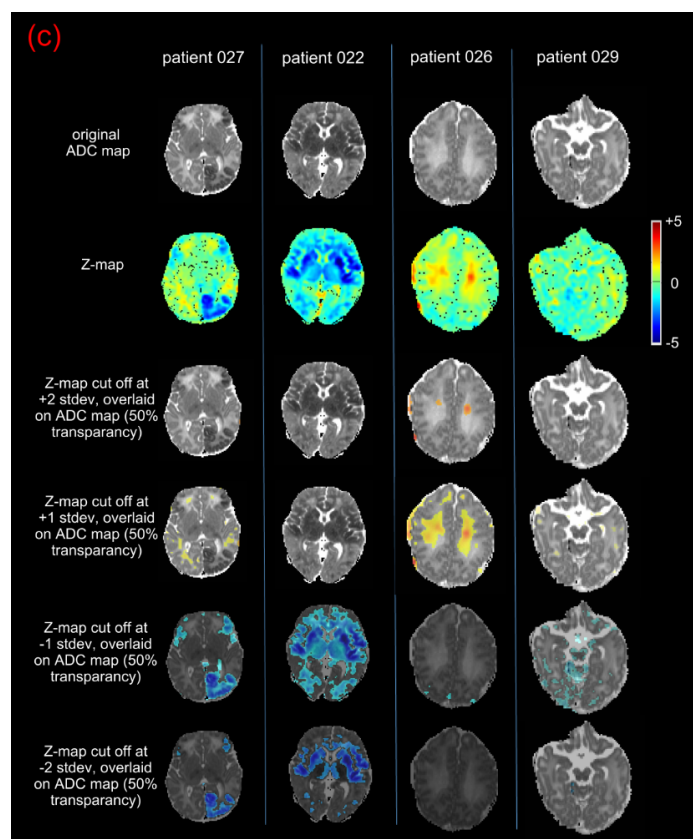
Figure from Howlett et al, Ped Res, 2013

Atlas-based Abnormality Detection

--- A naïve but intuitive approach



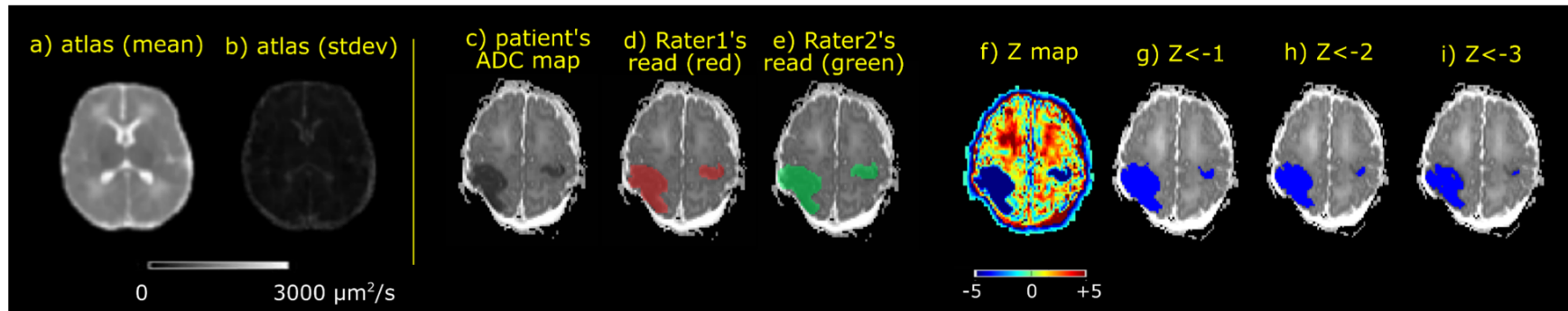
Atlas-based HIE detection



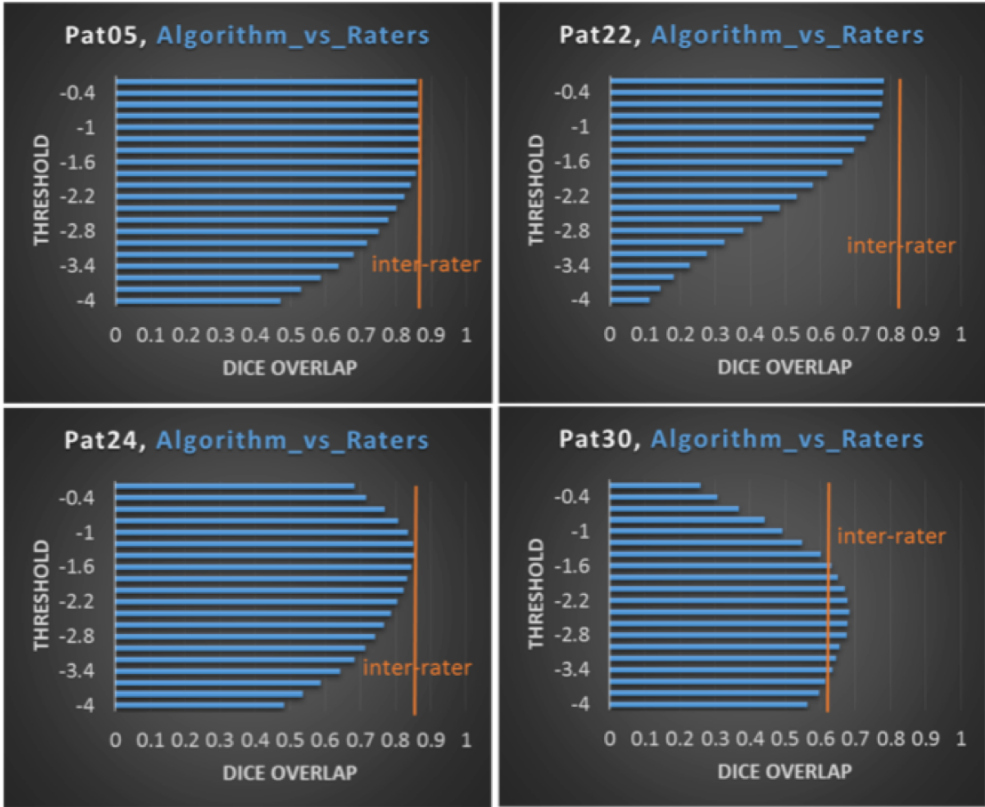
* Ou et al, OHBM, 2015, 2017

Accuracy of Z-map Approach

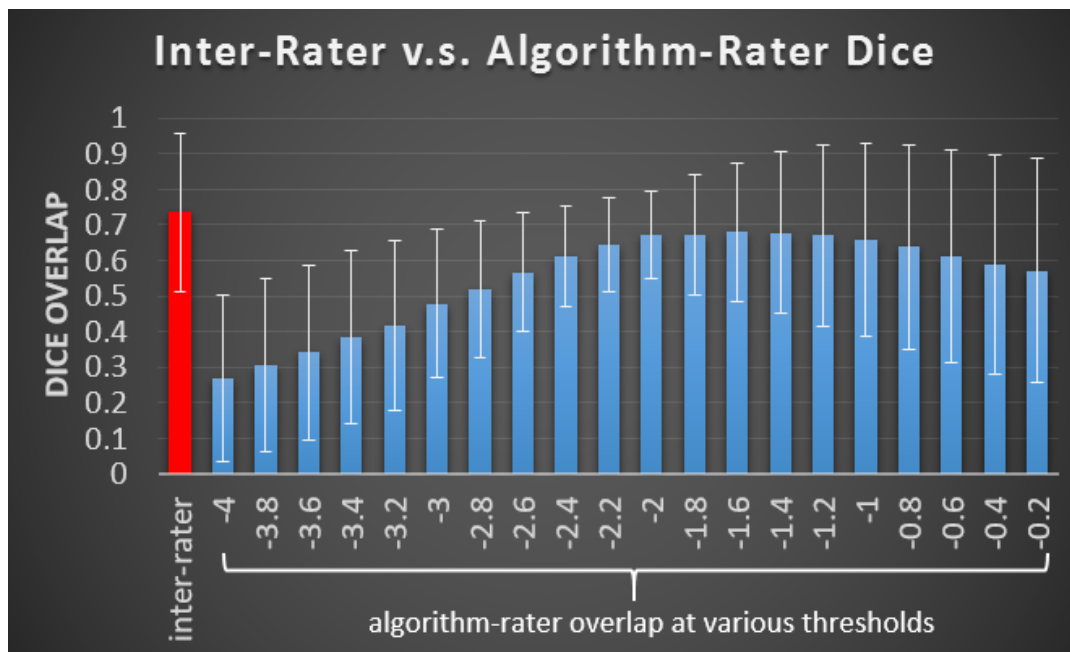
- Compare with expert annotations
- Machine-vs-Human =?= Human-vs-Human



Inter-rater Dice overlap compared to algorithm-rater Dice overlap

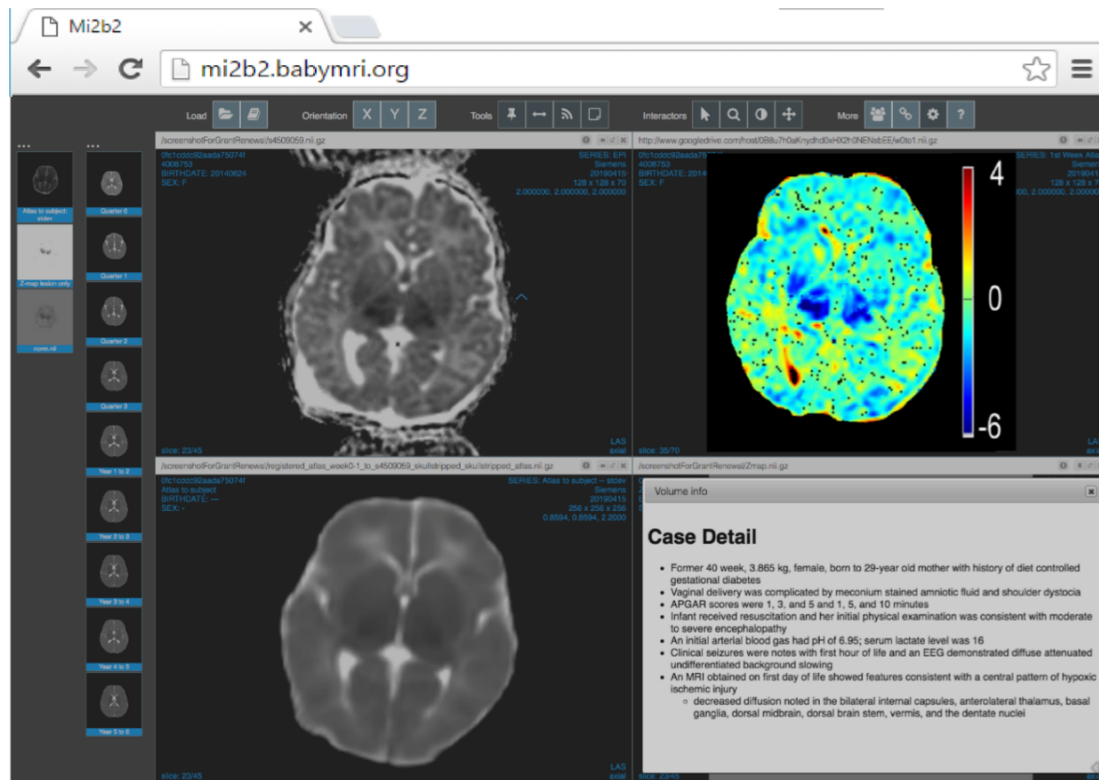


Accuracy of Z-map Approach (n = 6 cases, n = 2 raters)



An atlas-based **naïve** Z-map approach can provide a **good initiation** for lesion detection, approaching the accuracy of human experts

Ongoing Work – Bring to Radiology Classroom and Reading Room



The screenshot shows the 'Annotation' window with the 'RECIST' tab selected. The form is titled 'Neonatal brain MRI (Neonatal)' and includes the following fields:

Name: Baby1

Templates: Neonatal brain MRI (Neonatal)

Embolitic arterial stroke? Yes No

If yes, Clot, focal Clot, multifocal Focal ischemia Multifocal ischemia Other

HIE injury in the Deep gray nuclei? No Yes, in Thalamus Yes, in lentiform nucleus Yes, in caudate Yes, in hippocampus

HIE injury in white matter? No Yes, single focal lesion Yes, multifocal lesions Yes, diffuse lesions

HIE injury in cortex? No Yes, perirolandic Yes, anterior Yes, posterior

Save and Close

Structured Report template

Image analysis approach

- 1. Field of View Normalization [Ou'16 (pending)]

<https://www.nitrc.org/projects/normalizefov>

- 2. Skull Stripping [Ou'14; Doshi'14; Ou'16]

<https://www.nitrc.org/projects/picasso>

- 3. Automatic Structural Segmentation [Ou'14; Doshi'16]

<https://www.cbica.upenn.edu/sbia/software/MUSE>

- 4. Multi-modal/channel Fusion [Ou'11, '14]

<https://www.nitrc.org/projects/dramms>

- 5. Tissue Density and Morphometry [Davatzikos'97; Ou'11, '14]

<https://www.cbica.upenn.edu/sbia/software/dramms/tools/ravens.html>

- 6. Atlas Construction [Ou'14, '15, '16 (u.r.)]

<https://www.nitrc.org/projects/popdramms>

- 7. Lesion Detection [Ou'07, '09, '16a, '16b (u.r.)]

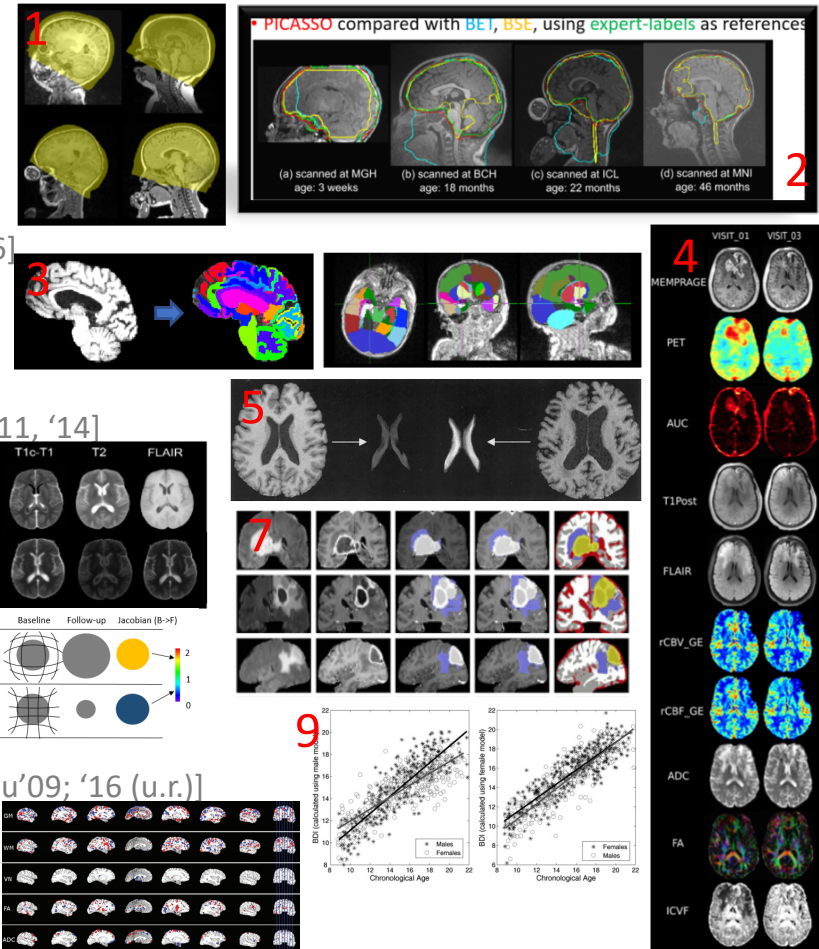
- 8. Longitudinal Change Quantification [Ou'15]

<https://www.cbica.upenn.edu/sbia/software/dramms>

- 9. Machine learning to predict clinical variables [Ou'09; '16 (u.r.)]

Based on DRAMMS Registration (2, 3, 4, 5D) [Ou'11, '12, '14a,b, '15]

Based on BEFI Machine Learning [Ou'09, '17 (u.r.)]



Acknowledgements

Neonatology

Sara Bates
Joseph Chou
Emily Herzberg
Yieh-Cheh Chen
Rebecca Weiss

FUNDING:

Partners Healthcare, NIH/NCBC; /NIMH;
/NCBI; /NCATS; /NIBIB
NIH RO1 EB014947

Imaging Informatics

Lilla Zollei
Steve Pieper
Kathy Andriole

Clinical Informatics

Shawn N Murphy
Yanbing Wang
Chris Herrick
David Wang

Boston Childrens Hospital

P. Ellen Grant
Yangming Ou
Rudolph Pienaar

rc.partners.org

RISC RESEARCH INFORMATION SCIENCE & COMPUTING

Login Events News Careers Contact Us Search

IT Services Research Apps & Services Support & Training Knowledge Base About

Identify Subjects / Request Data

- Research Patient Data Registry**
- RFDR Daily Query Tool
- Partners Biobank Portal
- mi2B2 Medical Image Access Tool
- Shared Data Sets (IDEA)
- Reporting Workbench (eCare)
- Partners eCare Research Core (PeRC)

Collect Data

- REDCap
- StudyTRAX
- LimeSurvey
- Freezerworks
- eLab Notebook

Analyze Data

- Bioinformatics Data Processing
- Medical Image Processing
- Statistics, Analysis and Visualization
- Big Data Analytics and Machine Learning

Boilerplates & Templates

- IT Facilities Security
- IT Infrastructure
- Applications & Support
- Data Use Agreements
- Research Thumbs-Up

Security

- Data Classification Reference Guide
- Research Data Classification
- IRB Review and VISPs
- Resources and Standard Operating Procedures
- Research IS Risk Assessments
- FISMA Security Documentation
- Current Cybersecurity Projects
- Cloud Security Provider Best Practices

A-Z Apps

Research Apps

Research applications and services support basic, biomedical and clinical research missions; focusing on the technical aspects of the research lifecycle.

Completed

- ✓ DIPR File Server Maintenance
- ✓ MySQL3 Server Updated on 12/17/17

[WEBSITE HOSTING »](#)

[SCIENTIFIC COMPUTING FAQS »](#)

[SAS LICENSES »](#)

Overview of the RPDR

The Research Patient Data Registry (RPDR) is a centralized clinical data registry, or data warehouse that gathers clinical information from various Partners hospital systems. An online Query Tool allows researchers to explore clinical data through a self-service system in order to:

- Assess clinical study feasibility
- Identify patients for clinical trials
- Investigate hospital operations and patient care
- Provide identified patient data with approved IRB protocol
- Find control patients for previously defined populations
- Search clinical notes for specific text terms and phrases in order to identify patient cohorts who have notes/reports that contain the searched text.
- Query for patients with blood samples in the Partners Biobank
- Supply a workbench that allows viewing and download access for MGH and BWH Radiology images

The RPDR ensures the security of patient information by controlling and auditing the distribution of patient data within the guidelines of the IRB and with the use of several built-in, automated security measures. The online search in real time results in a faster data turnaround with extensive specificity of patient criteria.

Functions of the RPDR

The RPDR has two related but separate functions:




- The online query tool provides users with aggregate numbers of patients that meet user-defined characteristics and criteria such as diagnoses, procedures, medications and/or laboratory results.
- The Data Request Wizards allow the user to ask for more detailed medical record information on the identified patient population. **This process requires an approved IRB protocol.**

Obtaining access to the RPDR

In order to use the RPDR, a person must first become registered in the RPDR system. Registration is handled differently for faculty vs. non-faculty members.

RPDR Access

In order to use the RPDR, a person must first become registered in the RPDR.

-  [Obtaining Access to the RPDR »](#)
-  [RPDR Tools »](#)
-  [Training »](#)

[CONTACT RPDR SUPPORT »](#)

RPDR Contacts

For help with the RPDR, please contact:

[Laurie Bogosian- User Liaison »](#)
857 282-3746

[Stacey Duey - Project Specialist »](#)
617 759-8248

[Mariah P. Mitchell - Corporate Manager- RPDR Group »](#)
857 282-3767

[Chris Herrick - Director of the RPDR Group »](#)
857 282-3758

[Shawn N. Murphy, MD, PhD Designer of the RPDR & Director for RISC »](#)
857 282-3769

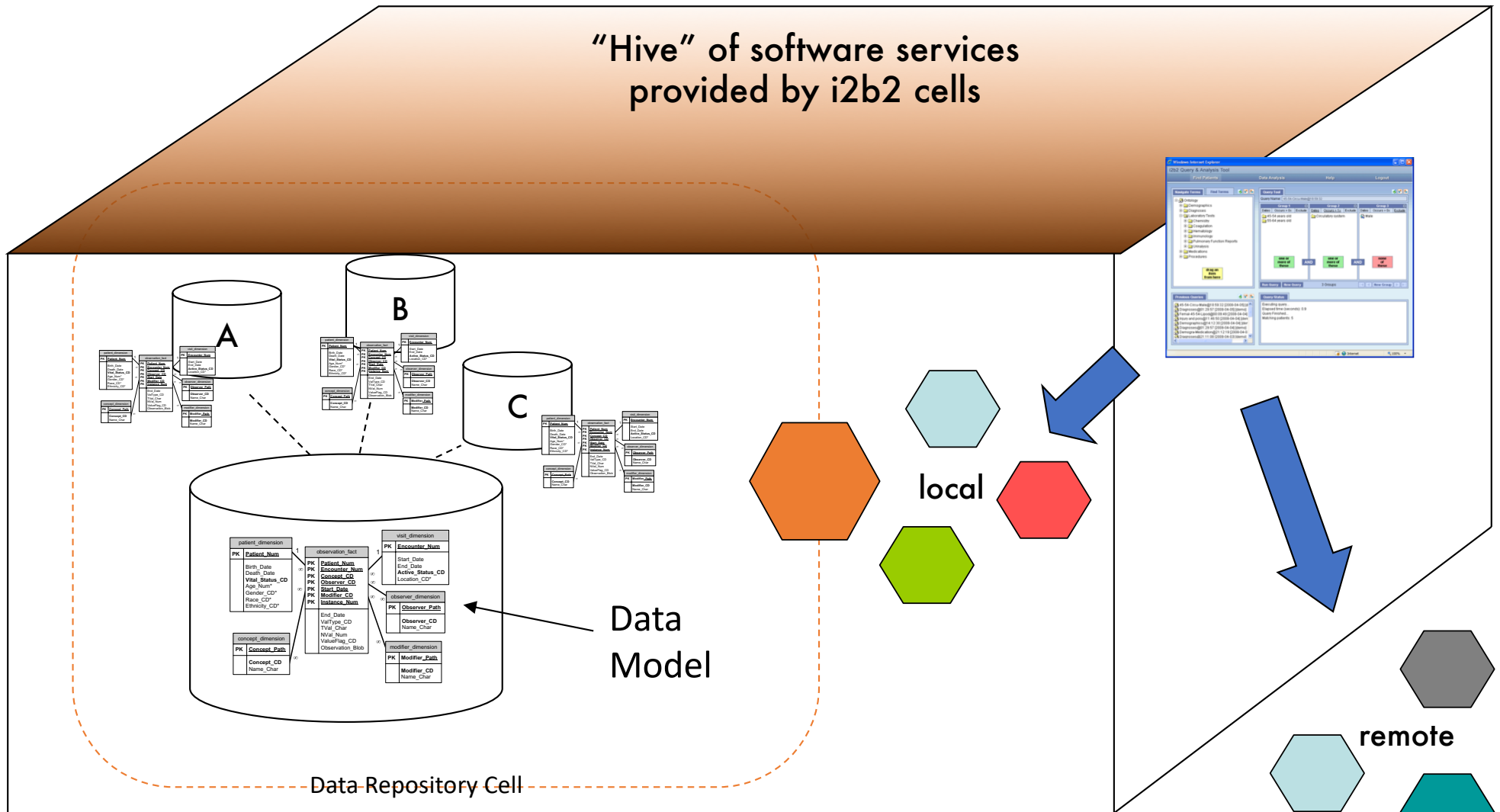
[RPDR MAILBOX »](#)

RPDR Evolved into international “Informatics for Integrating Biology and the Bedside (i2b2)” sponsored by the National Institutes of Health, what is it?

- Software for explicitly organizing and transforming person-oriented clinical data to a way that is optimized for clinical genomics research
 - Allows integration of clinical data, trials data, and genotypic data
- A portable and extensible application framework
 - Software is built in a modular pattern that allows additions without disturbing core parts
 - Available as open source at <https://www.i2b2.org>

An i2b2 Environment (the Hive) is built from i2b2 Cells

"Hive" of software services provided by i2b2 cells



Implementations (a sampling)

CTSA's

- Boston University
- Case Western Reserve University (*including Cleveland Clinic*)
- Children's National Medical Center (GWU), Washington D.C.
- Duke University
- Emory University (*including Morehouse School of Medicine and Georgia Tech*)
- Harvard University (*including Beth Israel Deaconess Medical Center, Brigham and Women's Hospital, Children's Hospital Boston, Dana Farber Cancer Center, Joslin Diabetes Center, Massachusetts General Hospital*)
- Medical University of South Carolina
- Medical College of Wisconsin
- Oregon Health & Science University
- Penn State Milton S. Hershey Medical Center
- Tufts University
- University of Alabama at Birmingham
- University of Arkansas for Medical Sciences
- University of California Davis
- University of California, Irvine
- University of California, Los Angeles*
- University of California, San Diego*
- University of California San Francisco
- University of Chicago
- University of Cincinnati (*including Cincinnati Children's Hospital Medical Center*)
- University of Colorado Denver (*including Children's Hospital Colorado*)
- University of Florida
- University of Kansas Medical Center
- University of Kentucky Research Foundation
- University of Massachusetts Medical School, Worcester
- University of Michigan
- University of Pennsylvania (*including Children's Hospital of Philadelphia*)
- University of Pittsburgh (*including their Cancer Institute*)
- University of Rochester School of Medicine and Dentistry
- University of Texas Health Sciences Center at Houston
- University of Texas Health Sciences Center at San Antonio
- University of Texas Medical Branch (Galveston)
- University of Texas Southwestern Medical Center at Dallas
- University of Utah
- University of Washington
- University of Wisconsin - Madison (*including Marshfield Clinic*)
- Virginia Commonwealth University
- Weill Cornell Medical College

Academic Health Centers (does not include AHCs that are part of a CTSA):

- Arizona State University
- City of Hope, Los Angeles
- Georgia Health Sciences University, Augusta
- Hartford Hospital, CN
- HealthShare Montana
- Massachusetts Veterans Epidemiology Research and Information Center (MAVERICK), Boston
- Nemours
- Phoenix Children's Hospital
- Regenstrief Institute
- Thomas Jefferson University
- University of Connecticut Health Center
- University of Missouri School of Medicine
- University of Tennessee Health Sciences Center
- Wake Forest University Baptist Medical Center

HMOs:

- Group Health Cooperative
- Kaiser Permanente

International:

- Georges Pompidou Hospital, Paris, France
- Hospital of the Free University of Brussels, Belgium
- Inserm U936, Rennes, France
- Institute for Data Technology and Informatics (IDI), NTNU, Norway
- Institute for Molecular Medicine Finland (FIMM)
- Karolinska Institute, Sweden
- Landspítali University Hospital, Reykjavik, Iceland
- Tokyo Medical and Dental University, Japan
- University of Bordeaux Segalen, France
- University of Erlangen-Nuremberg, Germany
- University of Goettingen, Goettingen, Germany
- University of Leicester and Hospitals, England (Biomed. Res. Informatics Ctr. for Clin. Sci)
- University of Pavia, Pavia, Italy
- University of Seoul, Seoul, Korea

Companies:

- Johnson and Johnson (TransMART)
- GE Healthcare Clinical Data Services

Use RPDR to access detailed clinical data

The screenshot displays the RPDR Enhanced Query Tool interface. At the top, the browser title is "RPDR Enhanced Query Tool - Microsoft Internet Explorer provided by Partners HealthCare System". The address bar shows the URL "http://rpdrweb/rpdrwebclient/querytool.aspx?res=768". The user is logged in as "Duey, Stacey A. in workgroup of Shawn Murphy, MD".

The interface includes several tabs: "Find Patients", "Match Controls", "Analyze Patients", "Request Detailed Data", "Request Specimens", "Understand Data", and "Get Help". The "Understand Data" tab is active.

The "Query Name" is "EGFR, Respiratory and... on 01/24/2011 #3". The search criteria include "GROUPS DO NOT HAVE TO OCCUR IN THE SAME VISIT" and "Sensitivity < Reset all groups to >0 >Specificity".

The "Query Items" section on the left shows a search for "egfr" and a list of categories including "EGFR" and "EGFR Gene Mutations (Group:EGFR)".

The "Query construction" section shows three groups of items. Group 1 of 3 includes "EGFR" and various mutations. Group 2 of 3 includes "Respiratory and intrathoracic organs" and "Malignant neoplasm of larynx". Group 3 of 3 includes "Malignant neoplasm of nasal cavities, paranasal sinuses, and accessory sinuses" and "Malignant neoplasm of other and ill-defined sites within the respiratory system and intrathoracic organs".

The "Results" section shows a "Run Query" button and a "Total count: 269±3 patient(s)". Below this, there are three charts: "Gender", "Age", and "Race".

Gender:

Gender	Count
Female	191±3
Male	75±3

Age:

Age Group	Count
Age 0-9 <3	3±3
Age 9-19 <3	3±3
Age 20-29	28±3
Age 30-39	75±3
Age 40-49	68±3
Age 50-59	62±3
Age 60-69	24±3
Age 70-79	7±3

Race:

Race	Count
A. Indian <3	25±3
A. Black	8±3
A. Hispanic	4±3
A. White	218±3
A. Other	3±3
A. Unknown	9±3

Person who is using tool

Query construction

Query items

Results - broken down by number distinct of patients

Research Patient Data Registry

SHOW ▼

Research Patient Data Registry (RPDR)

RPDR Daily Query Tool

SHOW ▼

The RPDR has a new Daily Query Tool where users can query source systems which are updated in the RPDR on a daily basis.

Partners Biobank Portal

SHOW ▼

Biobank Portal

mi2B2 Medical Image Access Tool

HIDE ▲

mi2b2 - Medical Image Access Tool

The Medical Imaging Informatics Bench to Bedside (mi2b2) workbench serves as a secure bridge between a researcher and the Partners PACS systems, which aims to:

- Facilitate searching for, previewing, and accessing clinically acquired images that are stored in several PACS (Picture Archive and Communication System) systems that serve the Partners institutions
- Enable researchers to extend the use of the Research Patient Data Registry (RPDR) to access clinical images on patients of interest for enhanced research studies, with proper IRB approval
- Enable efficient retrieval of medical images (DICOM format) for lists of patients generated from research, teaching and clinical activities in keeping with all regulatory guidelines
- Provide access to only patient images authorized by approved IRBs and provide audit trails for HIPAA compliance.

If using the RPDR Query tool and the RPDR Data Acquisition Engine (Image Request Wizard), a user can obtain aggregate numbers of patients with user-defined characteristics based on a query or upload a pre-defined list of Medical Record Numbers and then receive more detailed medical information about the queried patient cohort. Either way, the user is provided with a personalized mi2b2 workbench, directly configured to include the queried cohort information. It is delivered in an folder along with the encrypted RPDR data results. For instructions on how to use the RPDR to request mi2b2 workbench, please visit: (<http://RPDR>) ->Help -> Request Images Help.

Detailed tutorial support for new users of the mi2b2 software is found at <http://mi2b2help.partners.org>.

Use mi2b2 to access large medical image sets

The screenshot shows the RPDR Enhanced Query Tool interface in a Windows Internet Explorer browser. The address bar shows the URL: <https://rpdrssl.partners.org/RpdrWebClient/querytool.aspx?res=768>. The user is logged in as DUEY, Stacey A. in the workgroup of Gollub, Randy.

The interface features a navigation menu with the following options: Find Patients, Match Controls, Analyze Patients, Request Detailed Data, Request Specimens, Request Images, Understand Data, and Get Help. The 'Request Images' option is currently selected.

A large red text overlay reads "Wizard Selection" with a red arrow pointing to the "Using a query" option in the "Request Images" menu. A tooltip explains: "This option is used to create an imaging data request based on an existing query."

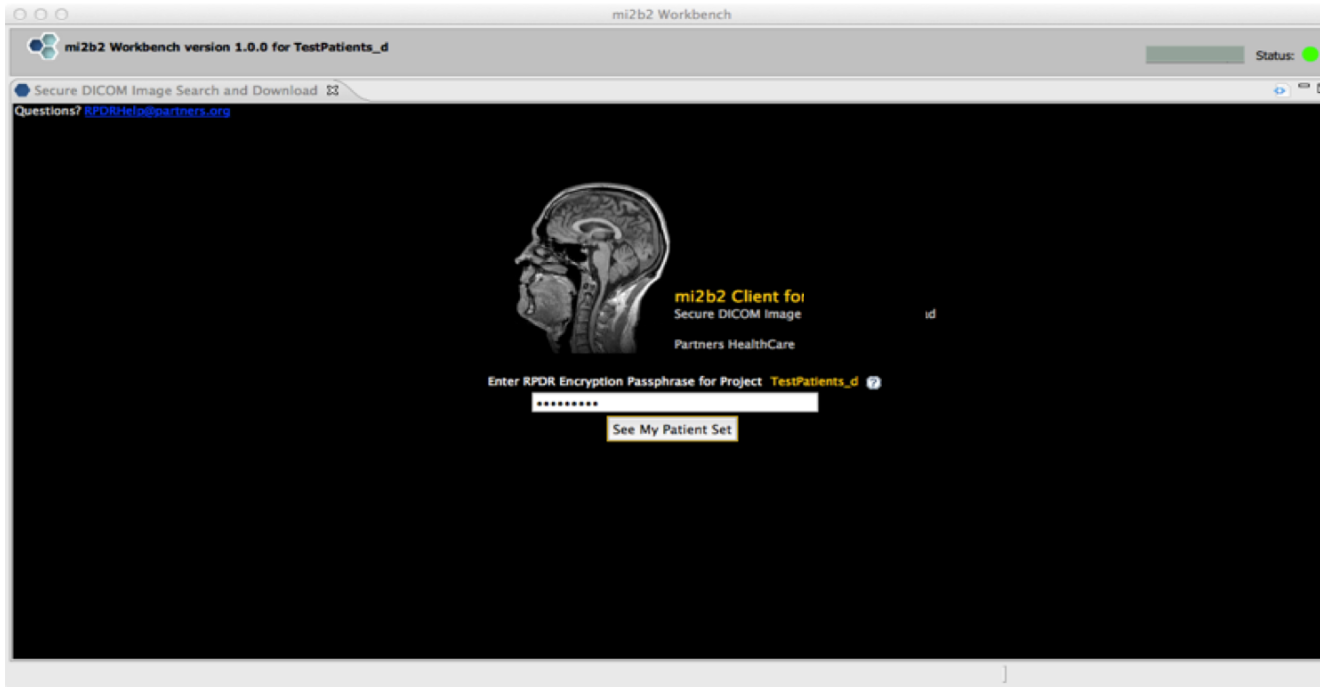
The main content area displays a table of queries. The selected query is "Erythromelalgia, BRAIN MRI (Test... on 11/27/2012 #2".

Query Name	By	Status	Date
BRAIN MRI ..., 75-84 year..., HI...	nar3	Ready	01/29/13 11:05:20
No Psych or Neuro - Jan 17 2013	vc07	Ready	01/17/13 17:13:34
0-9 years ..., Massachuse..., Ra...	vc070	Ready	01/08/13 17:57:23
0-9 years old, Massachusetts G....	vc070	Ready	01/08/13 16:18:20
0-14 years old on 01/08/2013	vc070	Ready	01/08/13 16:16:30
Head, Face and ..., 0-9 years ol...	nar30	Ready	12/20/12 11:34:18
Epilepsia ..., 0-9 years ..., HI...	nar30	Ready	12/20/12 11:32:42
0-9 years ..., Head, Face..., HI...	nar30	Ready	12/18/12 16:00:21
ⓧ Patient breakdowns for Detail fo...	nar30	Ready	12/17/12 09:22:08
Erythromelalgia, MR Brain w/Cont...	rg057	Ready	11/27/12 16:56:20
Erythromelalgia, BRAIN MRI (Tes...	rg057	Ready	11/27/12 16:49:06
Erythromelalgia on 11/27/2012 #2	rg057	Ready	11/27/12 16:48:26
ⓧ Erythromelalgia on 11/27/2012	rg057	Ready	11/27/12 16:42:04
ⓧ Erythromelalgia, BRAIN MRI (Test...	rg057	Ready	11/27/12 16:36:58
Atrial fib..., BRAIN MRI ..., Ac...	nar30	Ready	11/16/12 13:20:15
Atrial fib..., BRAIN MRI ..., Ac...	nar30	Ready	11/16/12 13:15:20
Atrial fib..., BRAIN MRI ..., Ac...	nar30	Ready	11/16/12 13:00:17

At the bottom of the query list, there are navigation buttons: First Page, Previous, Page 4 of 34, Next, Last Page. Below these buttons, it says "(565 queries)".

The wizard interface shows a "Run Query" button and a "Total count: 839±3 patient(s)" field. Below the wizard, there are four panels for filtering data: Gender (Female, Male), Age (40, 80), Race (I, A, B, H, W, O, U), and Vital (Alive, Deceased).

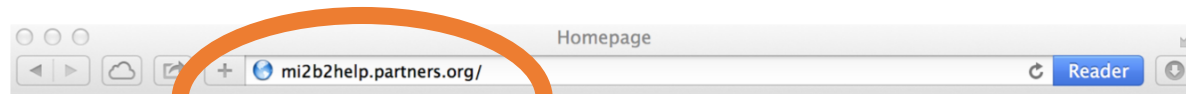
MI2B2 Workbench



mi2b2 Partners Tutorial
(<http://mi2b2help.partners.org>)

Mi2b2 at Partners Healthcare

- <http://mi2b2help.partners.org>



Disclaimer: All data has been de-identified and masked.

A tool customized for the Partners community

Many current and future clinical research studies rely on medical images for quantitative metrics for diagnosis, prognosis and treatment response. Images are used to quantify disease burden such as tumor volume, inflammation, hemorrhage, and infarction. Serial imaging is used to quantify the outcome of interventions, such as changes in tumor size or loss of brain tissue. Importantly, medical images are providing an ever increasing number of sensitive diagnostic approaches to disease, such as the use of susceptibility weighted and diffusion tensor MR imaging in the evaluation of brain trauma.

Initially developed with the support of an ARRA supplement to the Harvard Catalyst, the **Medical Imaging Informatics Bench to Bedside (mi2b2)** workbench aims to facilitate searching, acquiring, and previewing the aforementioned material that is stored in multiple **PACS** (Picture Archiving and Communication System) systems. It serves as a bridge between a user and the PACS, which may be housed across multiple institutions and departments (e.g. radiology, cardiology, or neurology).

This new release of the mi2b2 workbench enables researchers of the Partners Community to couple the use of the **Research Patient Data Registry** to the mi2b2 workbench's ability to access Radiology material stored in the Partners' network PACS systems.

Menu

Homepage

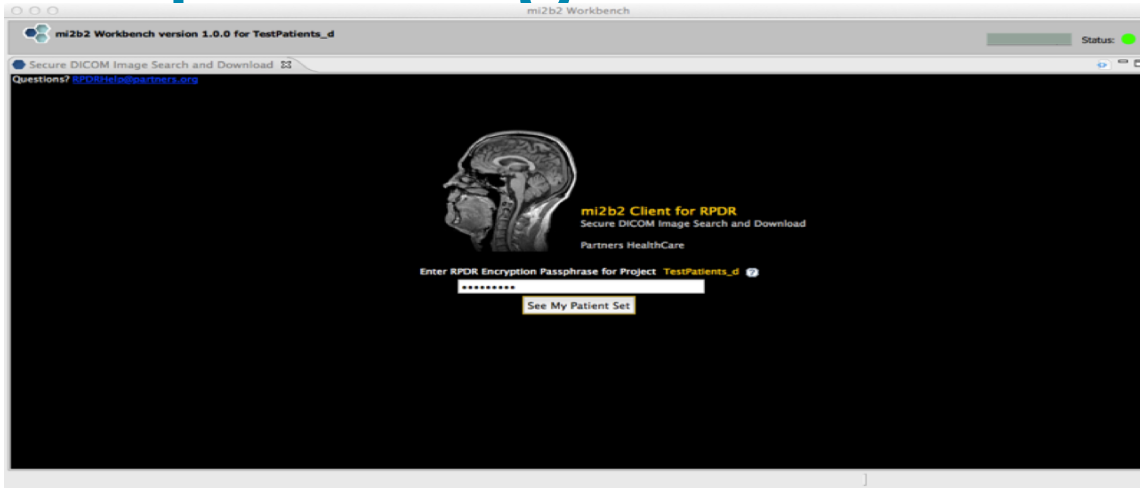
Getting Started

- I. Reviewing the Patients
- II. Requesting Studies
- III. Downloading Studies
- IV. Cache Management
- V. Image Viewer

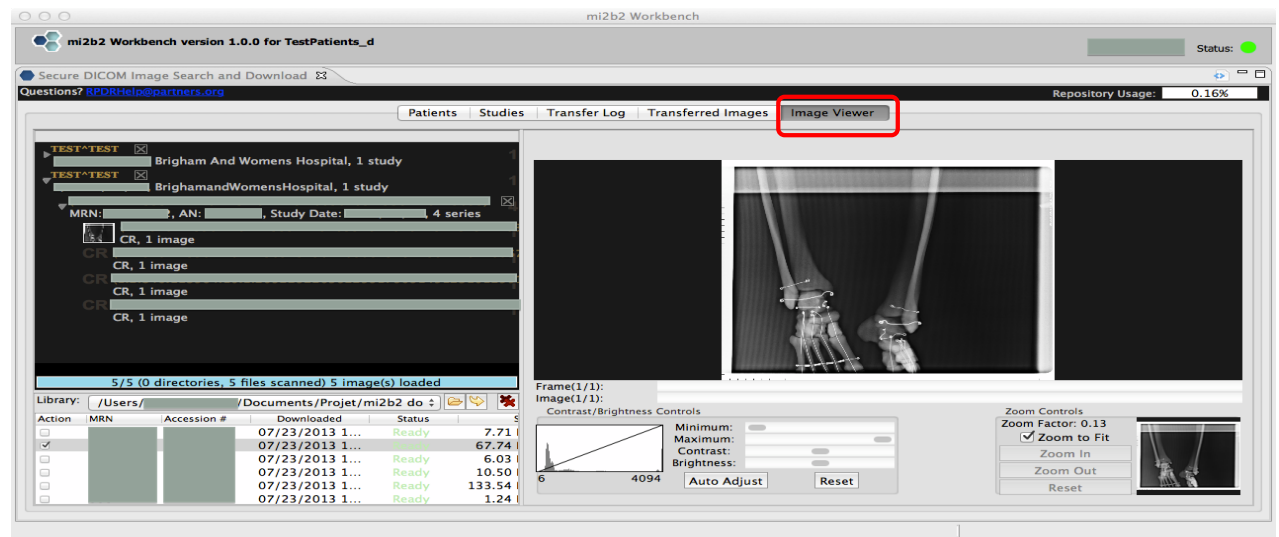
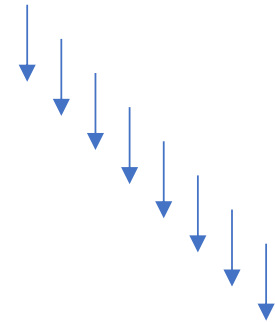
Links

- mi2b2 Open Source Client
- RPDR
- Help

Operating the mi2b2 Workbench



The user inputs the passphrase associated with the IRB protocol of the particular project in order to access the next windows.



Images are viewed in the Image Viewer and can be manipulated using the tools provided.

Managing Expectations

Weeks

Days

Using the RPDR mi2b2 workbench: 5 steps

The process of acquiring medical images associated with this RPDR-queried cohort consists of five steps, which are thoroughly described on the linked webpages of our tutorial (<http://mi2b2help.partners.org>). The following schematic summarizes the process, with an estimate of the time of completion of each step.



I. Reviewing Patients

Immediately after the user receives the RPDR query results package and launches the project-specific mi2b2 workbench.

Organizing images



II. Requesting studies

Some minutes - depends on the number of patients the user is requesting more information about.

QA images



III. Downloading studies

This is the rate-limiting step. The time depends on the number of requested studies, but also on the PACS availability, downtimes and maintenance. The minimum amount of time this step can be completed is one night.



IV. Cache Management

The time it takes for the studies to be downloaded to the local machine depends on the specifications of the network, the number of DICOM files, the scanning protocol as well as the study modality.

analyze images



V. Image Viewer

Once a study has been downloaded to the local machine, it takes at least a couple of minutes for it to be loaded to the Image Viewer.

If you have questions about this wizard or the process for requesting medical images, please send an email to [RPDR Help](#).

Home > News & Events > Announcements > New registry of early childhood Brain MRIs available through Partners Big Data Commons

New registry of early childhood Brain MRIs available through Partners Big Data Commons

GET HELP

October 23, 2017 9:35 am

The recently launched **Partners Clinical Image Bank** portal enables researchers to access registries of expertly curated, phenotypically characterized medical images and associated clinical data extracted from the Partners electronic medical records.

The first registry to be made available is a repository of pediatric brain MR images comprised of a cohort of neonates with clinically confirmed hypoxic ischemic encephalopathy (HIE), along with a cohort of “normative” children imaged between the ages of 0-6 years of age with no known CNS pathology. In addition to secure access to the DICOM image data, the portal allows interaction with and download of extracted quantitative metrics from the Apparent Diffusion Coefficient (ADC) maps calculated from the Diffusion Weighted Images for many of the cases.

Each HIE case also has detailed perinatal clinical course information including maternal risk factors, outcomes and much more.

Access to the Clinical Image Bank is available to all registered RPDR users who accept the terms of the Data Use Agreement.

Users with IRB approval who wish to download the fully identifiable clinical data and DICOM medical images may do so easily.

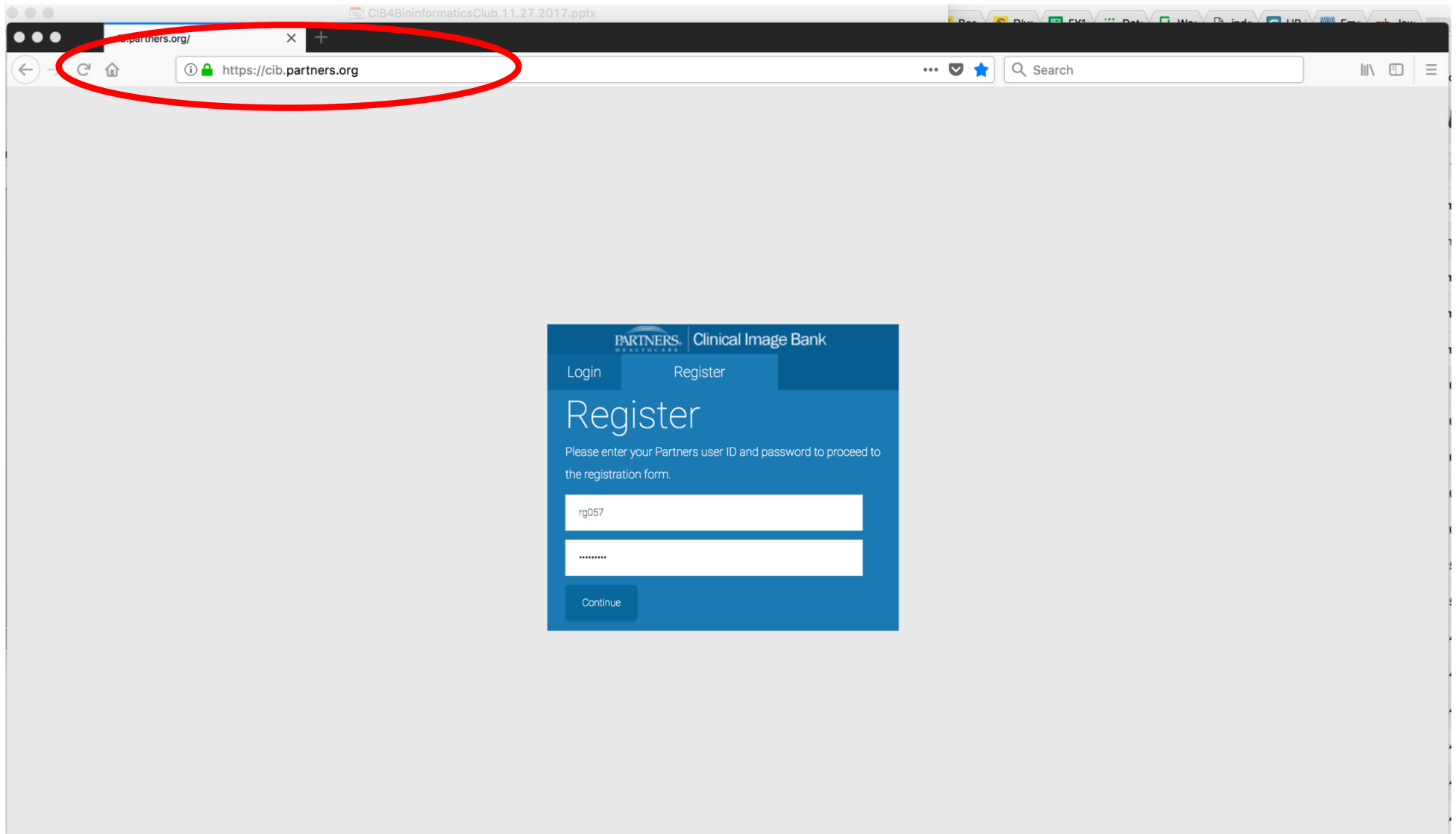
The Clinical Image Bank is available at <https://cib.partners.org/> or can be launched from the RPDR homepage at <http://rpd.partners.org>

For questions, suggestions for future expansion and feedback about the Clinical Image Bank, contact RPDRHelp@partners.org

CIB: Motivation and Goals

- The Clinical Image Bank seeks to make valuable collections of patient cohorts available to Partners investigators and their collaborators
 - Well curated phenotypes
 - Clinical images with secondary research utility
 - Clinical information not available in RPDR
- Easily accessible to support robust data mining
 - Web accessible with credentials
 - DUA simplifies management while maintaining patient privacy and all legal protections
- Enables cohort curation across phenotypes over time

CIB: Register from within firewall (use VPN)



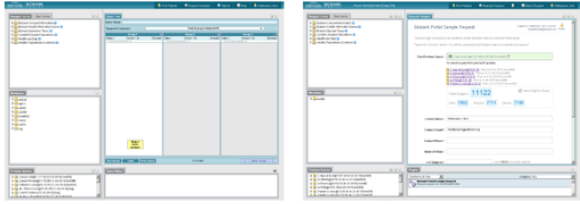
The screenshot shows a web browser window with the address bar highlighted in red, containing the URL `https://cib.partners.org`. The page displays the "Clinical Image Bank" registration interface. At the top, there are tabs for "Login" and "Register". The main heading is "Register", followed by the instruction: "Please enter your Partners user ID and password to proceed to the registration form." Below this, there are two input fields: the first contains the text "rg057" and the second contains a masked password ".....". A "Continue" button is located at the bottom of the form.

CIB: Sign the DUA

PARTNERS Clinical Image Bank

PARTNERS **Clinical Image Bank**

The Clinical Image Bank is a web-based query tool that allows Partners Investigators to query and download data from curated phenotypically characterized pediatric patient cohorts. You can also view and make requests for medical images directly from the image bank.



Find patients using the advanced query tool Request images from the Clinical Image Bank

Registration Form

Enter Your Information

Partners Username: * E-mail address: *

Full Name (e.g. Doe, John): *

Sign Data Use Agreement [\[Print this DUA \]](#) [\[View in new browser window \]](#)

Partners HealthCare Clinical Image Bank
Data Use Agreement - Clinical Image Bank Portal (September 11th, 2017)

Please read the terms of this Data Use Agreement ("Agreement") carefully before accessing the Partners HealthCare Clinical Image Bank Portal. The Clinical Image Bank Portal provides direct access to:

- (1) Limited Data Set health information, for purposes of running queries to determine the feasibility of conducting your potential research project(s) and the availability of clinical images for the project(s); and
- (2) Clinical Images and/or Limited Data Set health information, for purposes of conducting such project(s).

As used in this Agreement, "Limited Data Set" means health information that may include dates (such as admission dates and birth dates) and certain geographic information (city, state, and zip codes) but that excludes the

By checking this box, you agree to the Clinical Image Bank [Data Use Agreement](#).

 Job Title: *

Department: * Institution: *

Complete Registration

CIB: Login

PARTNERS HEALTHCARE | Clinical Image Bank

Login Register

Login

Please enter your Partners user ID and password:

CIB: Run a Query

The screenshot displays the Clinical Image Bank (CIB) interface. The top navigation bar includes the logo for PARTNERS HEALTHCARE Clinical Image Bank and several utility buttons: Find Patients, Make Table of Data, Get Images, Help, and VSG.

The main interface is divided into several sections:

- Navigate Terms:** A tree view on the left showing a hierarchy of terms. Under "Perinatal Data", "1. Vital Statistics - 162" is expanded, showing sub-terms like "1. Gestational age - 161", "2. Birth length - 79", "3. Birth weight - 161", "4. Birth head circumference - 97", and "5. Maternal age - 161".
- Workplace:** A central workspace containing a folder icon labeled "vsg".
- Previous Queries:** A list at the bottom left showing recent queries, including "BirthHeadCircumference@17:48:06 [9-27-2017] [vsg]".
- Query Tool:** The central panel where a query is defined. The query name is "BirthHeadCircumference@17:48:06". The query timing is set to "Non-Temporal Query: Treat all groups independently". The query is structured into three groups:
 - Group 1:** Contains "4. Birth head circumference".
 - Group 2:** Contains "5. Cohort - 364".
 - Group 3:** Is currently empty.Logical connectors "AND" are placed between the groups. Green boxes indicate "one or more of these" for the first two groups, and a yellow box indicates "drop a term on here" for the third group.
- Run Query:** A button to execute the query, with a "Clear" button and a "2 Groups" indicator.
- Results:** A section at the bottom right showing the query status, options for "Graph Results" and "Query Report", and a large display of the patient count: "NUMBER OF PATIENTS 97 For Query 'BirthHeadCircumference@17:48:06'".

CIB: Create a Table of Data

PARTNERS Clinical Image Bank Find Patients Make Table of Data Get Images Help VSG

Navigate Terms Find

- Transfusion - 176
- Imaging Data 1
- Perinatal Data 1
 - 1. Vital Statistics - 162
 - 1. Gestational age - 161
 - 2. Birth length - 79
 - 3. Birth weight - 161
 - 4. Birth head circumference - 97
 - 5. Maternal age - 161
 - 2. Maternal History - 162
 - 3. Labor and Delivery - 162
 - 4. Infant's Clinical Course - 162
 - 5. Cohort - 364
 - 6. NICU Outcomes - 159

Workplace

vsg

Previous Queries Find

- BirthHeadCircumference@17:48:06 [9-27-2017] [vsg]
- 4. Birt-5. Coho@17:47:55 [9-27-2017] [vsg]
- Brainstem Abs M@11:52:56 [9-22-2017] [vsg]
- Circula-Reason @11:30:13 [9-19-2017] [vsg]
- Circulatory sys@11:29:34 [9-19-2017] [vsg]

Patient Set Viewer

Define View Review Patients History Download Images

Patient Set Viewer View aggregated data for a set of patients and save a list to your workplace

Start by dragging and dropping a Previous Query below.

Patients: BirthHeadCircumference@17:48:06 [Patient Count: 97]

Concepts: Drag & Drop additional concepts here from *Navigate Terms* or a *Previous Query*. Or select a template

Concept [?]	Constraints	Aggregation Option	Include
Patient Number		Value	<input checked="" type="checkbox"/>
Gender		Value	<input checked="" type="checkbox"/>
Age		Value	<input checked="" type="checkbox"/>
Race		Value	<input checked="" type="checkbox"/>
4. Birth head circumference	[Set Date] [Set Value]	Existence (Yes/No)	[?] <input type="checkbox"/>
5. Cohort	[Set Date]	List of All Values	[?] <input type="checkbox"/>

Review Patients Reset

CIB: Review Patients

Navigate Terms Find

- (molecular medicine - 0)
- Procedures - 429
- PROMs - 1
- Providers
- Radiology tests - 392
- Reason for visit - 135
- [Specimens - 0]
- Transfusion - 176
- Imaging Data
- Perinatal Data
 - 1. Vital Statistics - 162
 - 1. Gestational age - 161
 - 2. Birth length - 79
 - 3. Birth weight - 161
 - 4. Birth head circumference - 87

Workplace

vsg

Previous Queries Find

- BirthHeadCircumference@17:48:06 [9-27-2017] [vsg]
- 4. Birt-5. Coho@17:47:55 [9-27-2017] [vsg]
- Brainstem Abs M@11:52:56 [9-22-2017] [vsg]

Patient Set Viewer

Define View Review Patients History Download Images

You are viewing rows 1-50 out of 97 rows, one row per patient.

Tools: [Download](#) | Download Status: **Download Data File**

Search:

Patient Number	Gender	Age	Race	4. Birth head circumference [List of All Values]	5. Cohort [All Concepts (Names/Text)]	Acquisition [Images (Yes/No)]
3	F	14	White	[35]	[2. Hypoxic Ischemic Encephalopathy (HIE)] [8. Other cohort type]	View
4	M	13	White	[37.5]	[2. Hypoxic Ischemic Encephalopathy (HIE)] [3. Stroke]	View
5	M	13	White	[30]	[2. Hypoxic Ischemic Encephalopathy (HIE)]	View
7	F	13	White	[32.5]	[2. Hypoxic Ischemic Encephalopathy (HIE)]	View
10	F	13	Unknown	[35]	[2. Hypoxic Ischemic Encephalopathy (HIE)]	View
13	M	12	Black	[36.5]	[2. Hypoxic Ischemic Encephalopathy (HIE)]	No
17	F	13	White	[33]	[2. Hypoxic Ischemic Encephalopathy (HIE)]	No
22	F	12	White	[31]	[2. Hypoxic Ischemic Encephalopathy (HIE)]	View
23	F	12	White	[35]	[2. Hypoxic Ischemic Encephalopathy (HIE)] [3. Stroke]	View
24	M	12	Black	[34]	[2. Hypoxic Ischemic Encephalopathy (HIE)]	View

CIB: View Timeline of available images

The screenshot displays the Clinical Image Bank (CIB) interface. The top navigation bar includes 'PARTNERS Healthcare Clinical Image Bank' and several action buttons: 'Find Patients', 'Make Table of Data', 'Get Images', 'Help', and 'VSG'.

On the left side, there are three panels:

- Navigate Terms:** A tree view showing categories like 'Procedures - 429', 'PROMs - 1', 'Providers', 'Radiology tests - 392', 'Reason for visit - 135', '[Specimens - 0]', 'Transfusion - 176', 'Imaging Data', and 'Perinatal Data'. Under 'Perinatal Data', '1. Vital Statistics - 162' is expanded to show '1. Gestational age - 161', '2. Birth length - 79', and '3. Birth weight - 161'.
- Workplace:** A workspace area containing a folder icon labeled 'vsg'.
- Previous Queries:** A list of recent queries such as 'BirthHeadCircumference@17:48:06 [9-27-2017] [vsg]', '4. Birt-5. Coho@17:47:55 [9-27-2017] [vsg]', 'Brainstem Abs M@11:52:56 [9-22-2017] [vsg]', 'Circula-Reason @11:30:13 [9-19-2017] [vsg]', and 'Circulatory sys@11:29:34 [9-19-2017] [vsg]'.

The main area is the **Patient Set Viewer**, which includes tabs for 'Define View', 'Review Patients', 'History', and 'Download Images'. It shows a message: 'You are viewing rows 1-50 out of 97 rows, one row per patient.' Below this, there are 'Tools: Download' and 'Download Status: Download Data File' buttons, along with a search box.

The central table displays patient data with the following columns: Patient Number, Gender, Age, Race, 4. Birth head circumference [List of All Values], 5. Cohort [All Concepts (Names/Text)], and Acquisition [Images (Yes/No)].

Patient Number	Gender	Age	Race	4. Birth head circumference [List of All Values]	5. Cohort [All Concepts (Names/Text)]	Acquisition [Images (Yes/No)]
3	F	14	White	[35]	[2. Hypoxic Ischemic Encephalopathy (HIE)] [8. Other cohort type]	View
4	M	13	White	[37.5]	[2. Hypoxic Ischemic Encephalopathy (HIE)] [3. Stroke]	View
5	M	13	White	[30]	[2. Hypoxic Ischemic Encephalopathy (HIE)]	View
7	F	13	White	[32.5]	[2. Hypoxic Ischemic Encephalopathy (HIE)]	View
10	F	13	Unknown	[35]	[2. Hypoxic Ischemic Encephalopathy (HIE)]	View
13	M	12	Black	[36.5]	[2. Hypoxic Ischemic Encephalopathy (HIE)]	No
17	F	13	White	[33]	[2. Hypoxic Ischemic Encephalopathy (HIE)]	No
22	F	12	White	[31]	[2. Hypoxic Ischemic Encephalopathy (HIE)]	View

At the bottom of the Patient Set Viewer, there is a **Timeline** view showing 'Acquisition' points on a scale from 12 to 20. A blue bar highlights the acquisition point at age 12, and another point is visible at age 20.

CIB: View thumbnails of images

The screenshot displays the Partners Clinical Image Bank web client interface. The browser address bar shows <https://cib.partners.org/webclient/#>. The main navigation bar includes "PARTNERS Clinical Image Bank" and utility buttons: "Find Patients", "Make Table of Data", "Get Images", "Help", and "RG057".

The interface is divided into several panels:

- Navigate Terms:** A tree view showing categories like "Healthcare Data", "Imaging Data", "Perinatal Data", and "5. Cohort - 364".
- Workplace:** A workspace area containing a folder named "rg057".
- Previous Queries:** A list of saved queries such as "0-1years.ADC.HIE@16:33:03 [9-27-2017] [rg057]".
- Patient Set Viewer:** The central panel showing a table of patient data. It includes tabs for "Define View", "Review Patients", "History", and "Download Images". A message states: "You are viewing rows 26-50 out of 197 rows, one row per patient." A "Download CSV" button is present.

The patient data table has the following columns: Patient Number, Gender, Age, Race, 5. Cohort [All Concepts (Names/Text)], Apparent Diffusion Coefficient [Existence (Yes/No)], and Acquisition [Images (Yes/No)].

Patient Number	Gender	Age	Race	5. Cohort [All Concepts (Names/Text)]	Apparent Diffusion Coefficient [Existence (Yes/No)]	Acquisition [Images (Yes/No)]	
66	M	12	White	[1. Normative]	Yes	View	
67	F	9	White	[1. Normative]	Yes	View	
75	M	11	White	[1. Normative]	Yes	View	
Acquisition							
		Fri 18	Sat 19	Sun 20	Mon 21	Tue 22	Wed 23
February 2011							
78	F	9	White	[1. Normative]	Yes	No	
84	M	9	White	[1. Normative]	Yes	View	

A modal window titled "Patient 75 at 2011-02-20T09:25:11.000-05:00" is open, displaying three MRI image thumbnails: two axial slices and one sagittal slice.

CIB: Download data

The screenshot displays the Partners Clinical Image Bank web client interface. The browser address bar shows the URL <https://cib.partners.org/webclient/#>. The interface includes a navigation pane on the left with a tree view of data categories such as Healthcare Data, Imaging Data (with sub-categories like Apparent Diffusion Coefficient, Regional Mean ADC, etc.), DICOM Data, Images, and Perinatal Data. A 'Workplace' section shows a patient set named 'rg057'. The main area is the 'Patient Set Viewer' for 'rg057', displaying a table of patient data and a calendar view for 2016. A dialog box is open over the table, asking 'What should Firefox do with this file?' for the file 'Download_rg057_2017-11-22.csv' (5.0 KB). The dialog offers options to 'Open with Microsoft Excel (default)', 'Save File', or 'Do this automatically for files like this from now on.' The table data is as follows:

Patient Number	Gender	Age	Race	Weight (kg)	Diagnosis	ADC [Images (Yes/No)]
414	F	0				View
415	M	0				View
418	M	0				View
419	M	0				View
421	M	0	White	[35.5]	[2. Hypoxic Ischemic Encephalopathy (HIE)]	View
422	M	0	White	[32]	[2. Hypoxic Ischemic Encephalopathy (HIE)]	View
424	F	0	White	[33]	[2. Hypoxic Ischemic Encephalopathy (HIE)]	View
425	M	0	White	[31]	[2. Hypoxic Ischemic Encephalopathy (HIE)]	View
428	F	0	Unknown	[35]	[2. Hypoxic Ischemic Encephalopathy (HIE)]	View

Below the table, there is a 'Previous 25 Patients' button. The 'Previous Queries' section at the bottom left lists several search queries, including '4. Bi-5. Co-ADC@15:52:50 [11-22-2017] [rg057]' and 'FLAIR-Front-Full term neonate with problems@15:50:24 [11-22-2017] [rg057]'.

CIB: Download data

1	Gender	Age	Race	4. Birth head circumference	5. Cohort [All Concepts (Names/Text)]
2	F	14	White	[35]	[2. Hypoxic Ischemic Encephalopathy (HIE)] [8. Other cohort type]
3	M	13	White	[37.5]	[2. Hypoxic Ischemic Encephalopathy (HIE)] [3. Stroke]
4	M	13	White	[30]	[2. Hypoxic Ischemic Encephalopathy (HIE)]
5	F	13	White	[32.5]	[2. Hypoxic Ischemic Encephalopathy (HIE)]
6	F	13	Unknown	[35]	[2. Hypoxic Ischemic Encephalopathy (HIE)]
7	M	12	Black	[36.5]	[2. Hypoxic Ischemic Encephalopathy (HIE)]
8	F	13	White	[33]	[2. Hypoxic Ischemic Encephalopathy (HIE)]
9	F	12	White	[31]	[2. Hypoxic Ischemic Encephalopathy (HIE)]
10	F	12	White	[35]	[2. Hypoxic Ischemic Encephalopathy (HIE)] [3. Stroke]
11	M	12	Black	[34]	[2. Hypoxic Ischemic Encephalopathy (HIE)]
12	F	10	Asian	[34]	[3. Stroke]
13	M	9	White	[36]	[2. Hypoxic Ischemic Encephalopathy (HIE)]
14	F	8	Unknown	[32.5]	[2. Hypoxic Ischemic Encephalopathy (HIE)] [3. Stroke]
15	F	0	White	[31]	[2. Hypoxic Ischemic Encephalopathy (HIE)]
16	F	7	White	[34.5]	[2. Hypoxic Ischemic Encephalopathy (HIE)]
17	F	0	Unknown	[35]	[2. Hypoxic Ischemic Encephalopathy (HIE)]
18	M	7	Black	[35.35]	[2. Hypoxic Ischemic Encephalopathy (HIE)]
19	F	7	White	[34]	[2. Hypoxic Ischemic Encephalopathy (HIE)]
20	M	10	Unknown	[37]	[8. Other cohort type]
21	M	6	Unknown	[34]	[2. Hypoxic Ischemic Encephalopathy (HIE)]
22	F	6	Other	[35]	[2. Hypoxic Ischemic Encephalopathy (HIE)]
23	F	6	White	[34.5]	[2. Hypoxic Ischemic Encephalopathy (HIE)]
24	F	6	Unknown	[32]	[2. Hypoxic Ischemic Encephalopathy (HIE)]
25	F	5	Black	[36]	[2. Hypoxic Ischemic Encephalopathy (HIE)]
26	M	5	Black	[36]	[8. Other cohort type]



Download Images

The Clinical Image Bank offers downloadable image packages depending on your need. Identified images are served in DICOM format.

After your request is processed, your images will be made available on either the [ERISOne Linux Computing Cluster](#) or the [HPCWIN3 Windows Analysis Server](#).

Please complete the form below:

Request Type*: DICOM Images (Identified)

Identified requests can only be processed if you have a valid IRB protocol. Please enter your IRB number below.

An IRB number is required for your identified image request.

IRB Number*:

An IRB approval letter is required to be uploaded with your identified image request.

IRB Approval Letter*: No file selected.

Distribution Type*: I Don't Know Linux Windows

Image Package*:

Contact Name*:

Contact E-mail*:

Contact Phone*:

Principal Investigator Name*:

Name of Study*:

Please enter any other relevant comments/details about your request.

Partner



PARTNERS Clinical Image

Navigate Terms Find

- Healthcare Data
- Imaging Data
 - Apparent Diffusion Co
 - Regional Mean AD
 - Brainstem/Cere
 - Cortical Gray M
 - CSF
 - Subcortical
 - White Matter
 - Regional Volume
 - DICOM Data - 403
 - Images - 325
 - DWI - 311
 - FLAIR - 74
 - T1 - 258
 - T2 - 273
 - Perinatal Data

Workplace

rg057

Previous Queries Find

- 4. Bi-5, Co-ADC@15:52
- FLAIR-Front-Full term n
- 4. Bi-5, Co-Appar@15:4
- Female-Thalamu@15:4
- 5. Coho-Apparen@14:0
- D ve-Annar? Hv@14:0

CIB: Currently available data

The screenshot displays the Clinical Image Bank (CIB) interface, showing a hierarchical tree of data categories. The interface includes a top navigation bar with the logo for PARTNERS HEALTHCARE and the title 'Clinical Image Bank'. Below the navigation bar, there are several tabs: 'Navigate Terms', 'Find', and 'Query Tool'. The main content area is divided into two panels, both showing a hierarchical tree of data categories. The left panel shows a tree with categories like 'Transfusion - 176', 'Imaging Data', 'Perinatal Data', and '1. Vital Statistics - 162'. The right panel shows a tree with categories like 'Images - 325', 'Perinatal Data', '1. Vital Statistics - 162', '2. Maternal History - 162', '3. Labor and Delivery - 162', '4. Infant's Clinical Course - 162', '5. Cohort - 364', and '6. NICU Outcomes - 159'. The '5. Cohort - 364' category is highlighted with a red circle in both panels. Below the main content area, there is a 'Workplace' section with a folder icon labeled 'vsg'. At the bottom, there is a 'Previous Queries' section with a list of queries and their corresponding dates and user information.

Navigation Bar: PARTNERS HEALTHCARE Clinical Image Bank | Find Patients | Make Table of Data | Get Images | Help | VSG

Left Panel (Navigate Terms):

- Transfusion - 176
- Imaging Data
- Perinatal Data
 - 1. Vital Statistics - 162
 - 1. Gestational age - 161
 - 2. Birth length - 79
 - 3. Birth weight - 161
 - 4. Birth head circumference - 97
 - 5. Maternal age - 161
 - 2. Maternal History - 162
 - 3. Labor and Delivery - 162
 - 4. Infant's Clinical Course - 162
 - 5. Cohort - 364
 - 6. NICU Outcomes - 159

Right Panel (Navigate Terms):

- Images - 325
- Perinatal Data
 - 1. Vital Statistics - 162
 - 2. Maternal History - 162
 - 3. Labor and Delivery - 162
 - 4. Infant's Clinical Course - 162
 - 5. Cohort - 364
 - 1. Normative - 194
 - 2. Hypoxic Ischemic Encephalopathy (HIE) - 144
 - 3. Stroke - 23
 - [4. Inborn Error of Metabolism (IEM) - 0]
 - [5. Infection - 0]
 - [6. Hydrocephalus - 0]
 - [7. Congenital brain malformation - 0]
 - 8. Other cohort type - 17
 - 6. NICU Outcomes - 159

Workplace: vsg

Previous Queries:

- BirthHeadCircumference@17:48:06 [9-27-2017] [vsg]
- 4. Birt-5. Coho@17:47:55 [9-27-2017] [vsg]
- Brainstem Abs M@11:52:56 [9-22-2017] [vsg]
- Circula-Reason @11:30:13 [9-19-2017] [vsg]
- Circulatory sys@11:29:34 [9-19-2017] [vsg]

Detailed information on NICU care

PARTNERS HEALTHCARE Clinical Image Bank Find Patients Make Table of Data Get Images Help VSG

Navigate Terms Find Query Tool

- Transfusion - 176
- Imaging Data
- Perinatal Data
 - 1. Vital Statistics - 162
 - 1. Gestational age - 161
 - 2. Birth length - 79
 - 3. Birth weight - 161
 - 4. Birth head circumference - 97
 - 5. Maternal age - 161
 - 2. Maternal History - 162
 - 3. Labor and Delivery - 162
 - 4. Infant's Clinical Course - 162**
 - 1. Was the infant born at MGH? - 161
 - 2. Delivery Room Course - 162
 - 1. Was resuscitation required at delivery? - 162
 - 2. Apgar scores - 161
 - 3. Postnatal Course - 162
 - 1. Encephalopathy - 160
 - 2. Passive cooling - 161
 - 3. Therapeutic hypothermia - 161
 - 1. Yes, therapeutic hypothermia was initiated - 78
 - 2. No, therapeutic hypothermia was not initiated - 82
 - 3. Unknown if therapeutic hypothermia was initiated - 1
 - 4. Seizures - 161
 - 5. Extracorporeal membrane oxygenation (ECMO) - 161
 - 6. Total parenteral nutrition (TPN) - 161
 - 7. Medications given outside the DR/OR - 153
 - 5. Cohort - 364
 - 6. NICU Outcomes - 159

Workplace

- vsg

Previous Queries Find

- BirthHeadCircumference@17:48:06 [9-27-2017] [vsg]
- 4. Birt-5. Coho@17:47:55 [9-27-2017] [vsg]
- Brainstem Abs M@11:52:56 [9-22-2017] [vsg]
- Circula-Reason @11:30:13 [9-19-2017] [vsg]
- Circulatory sys@11:29:34 [9-19-2017] [vsg]

CIB: Clinical outcome measures

PARTNERS Clinical Image Bank Find Patients Make Table of Data Get Images Help VSG

Query Tool

Navigate Terms Find

- Transfusion - 176
- Imaging Data
- Perinatal Data
 - 1. Vital Statistics - 162
 - 1. Gestational age - 161
 - 2. Birth length - 79
 - 3. Birth weight - 161
 - 4. Birth head circumference - 97
 - 5. Maternal age - 161
 - 2. Maternal History - 162
 - 3. Labor and Delivery - 162
 - 4. Infant's Clinical Course - 162
 - 5. Cohort - 364
 - 6. NICU Outcomes - 159**

Workplace

- vsg

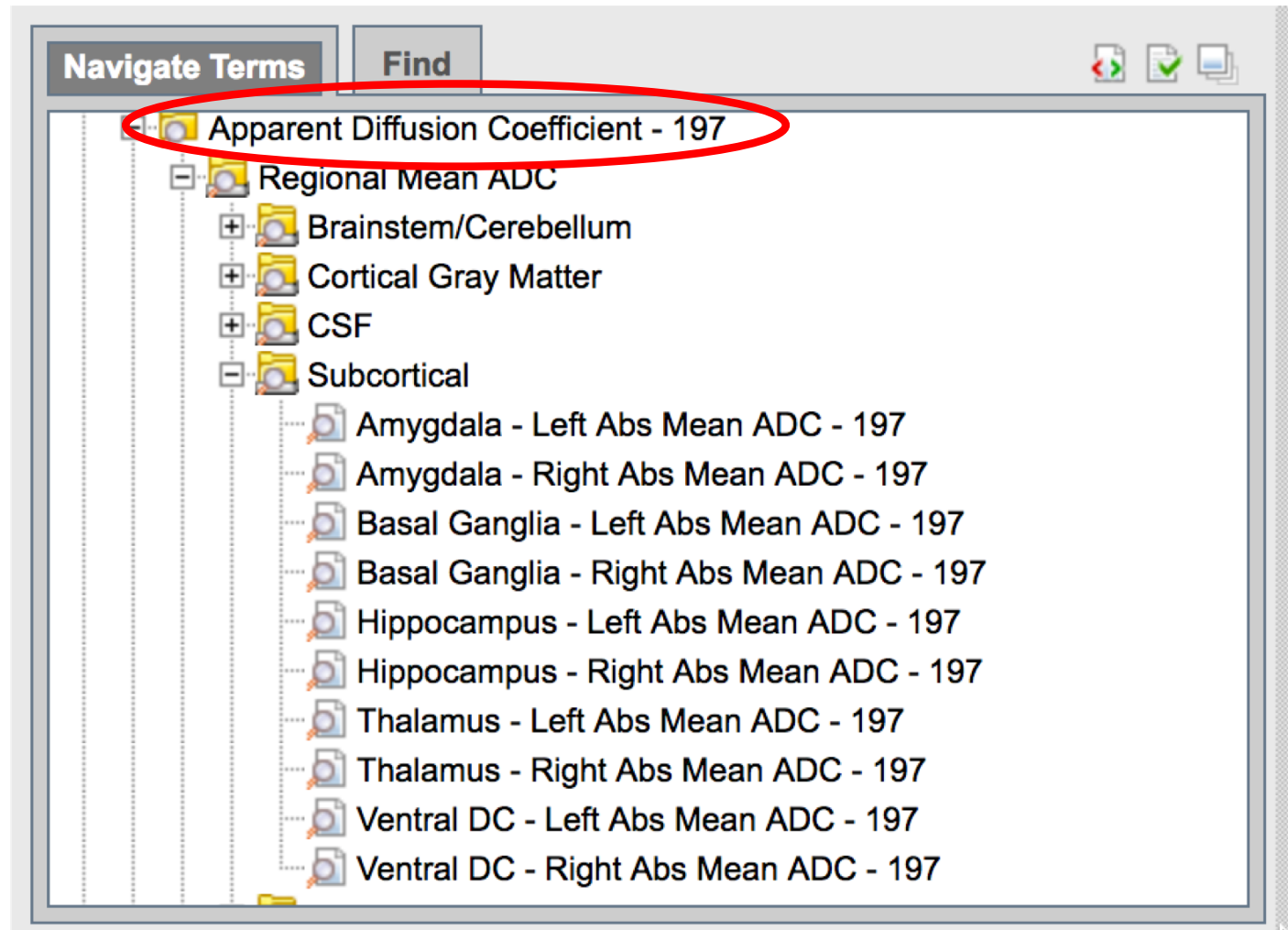
Previous Queries Find

- BirthHeadCircumference@17:48:06 [9-27-2017] [vsg]
- 4. Birt-5. Coho@17:47:55 [9-27-2017] [vsg]
- Brainstem Abs M@11:52:56 [9-22-2017] [vsg]
- Circula-Reason @11:30:13 [9-19-2017] [vsg]
- Circulatory sys@11:29:34 [9-19-2017] [vsg]

Navigate Terms Find

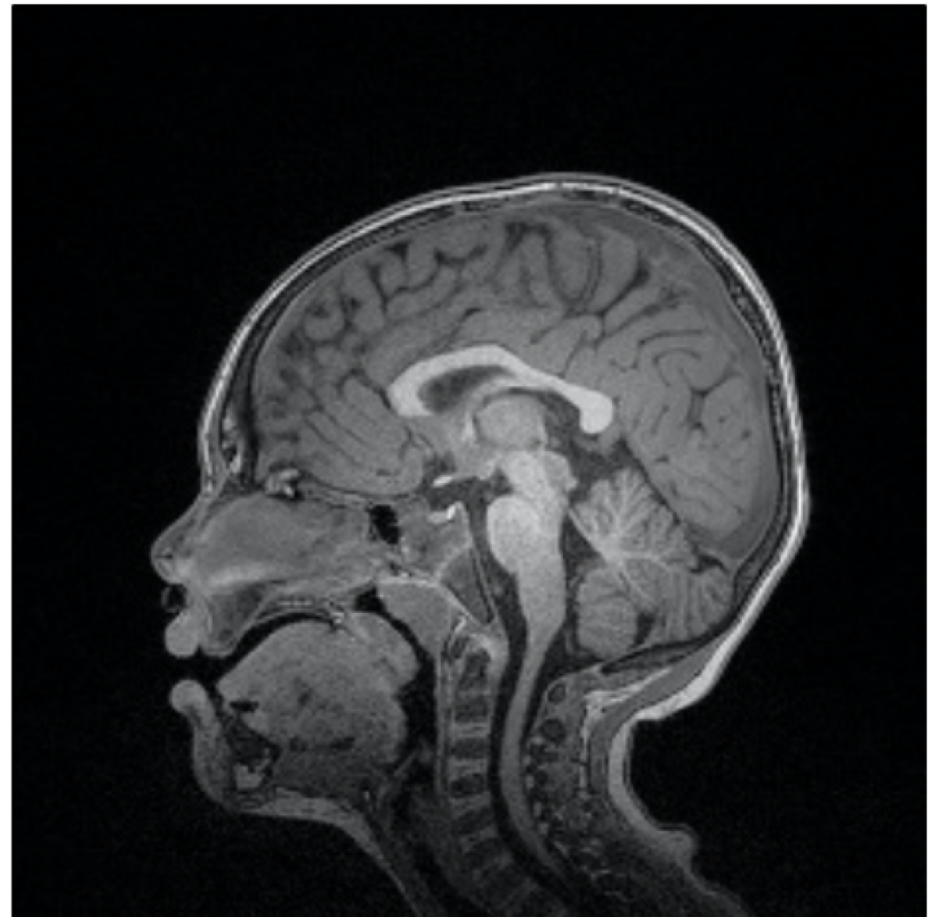
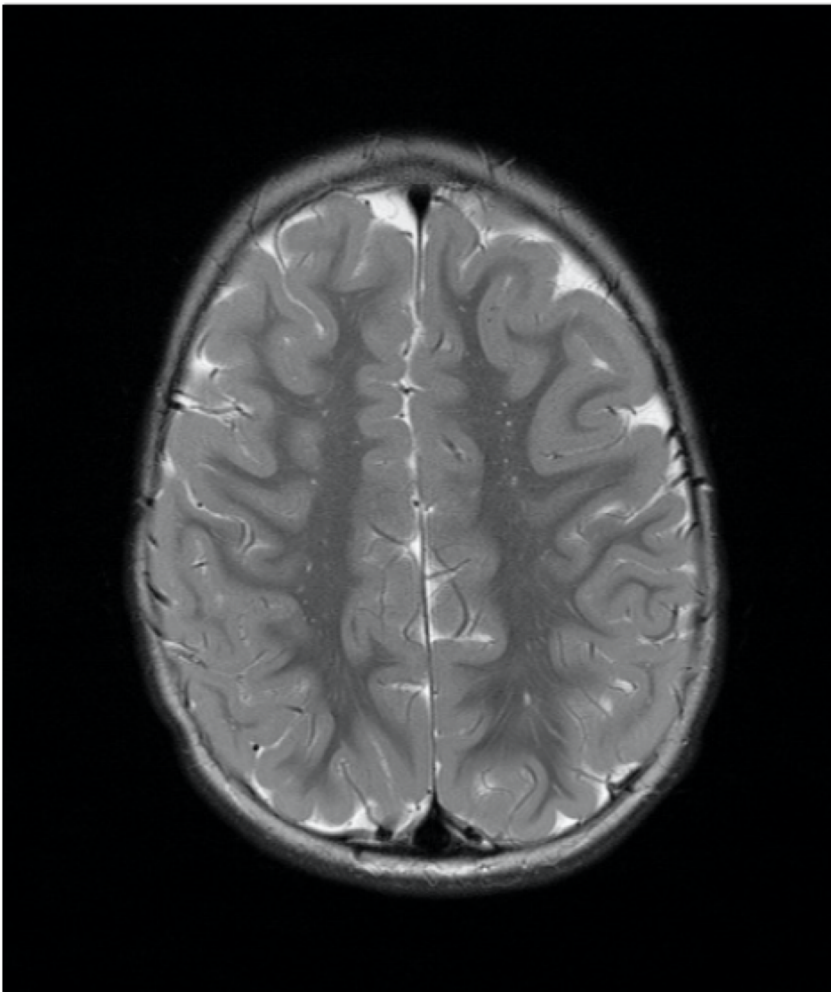
- 6. NICU Outcomes - 159**
 - 1. Length of stay - 158
 - 2. Initial disposition from the hospital - 159
 - 1. Discharged home - 129
 - 2. Transferred - 21
 - 3. Deceased - 25
 - [4. Other - 0]
 - [5. Initial Disposition Unknown - 0]
 - 3. Neurology outpatient follow-up - 149
 - 4. Newborn developmental follow-up clinic - 34
 - 5. Outcome Diagnoses - 137
 - [1. Developmental Delay Documented? - 0]
 - [2. Cerebral Palsy? - 0]
 - 3. Visual Impairment? - 136
 - 4. Hearing Impairment? - 136
 - 5. Seizures? - 137

CIB: Quantitative Imaging Metrics

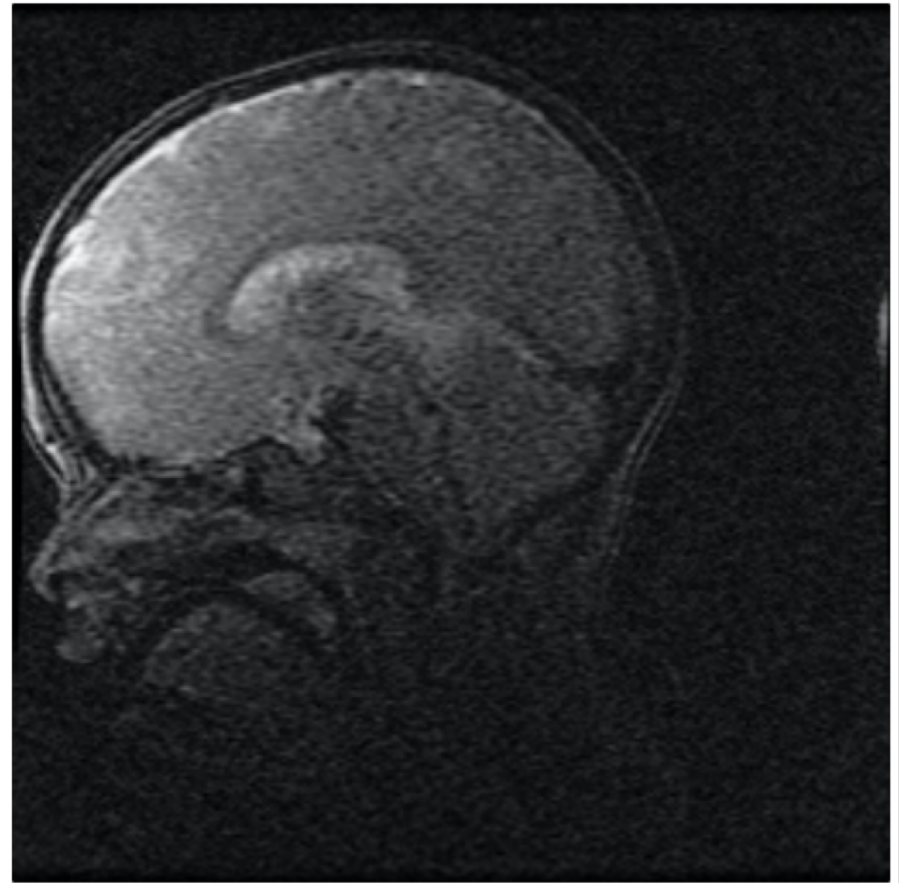
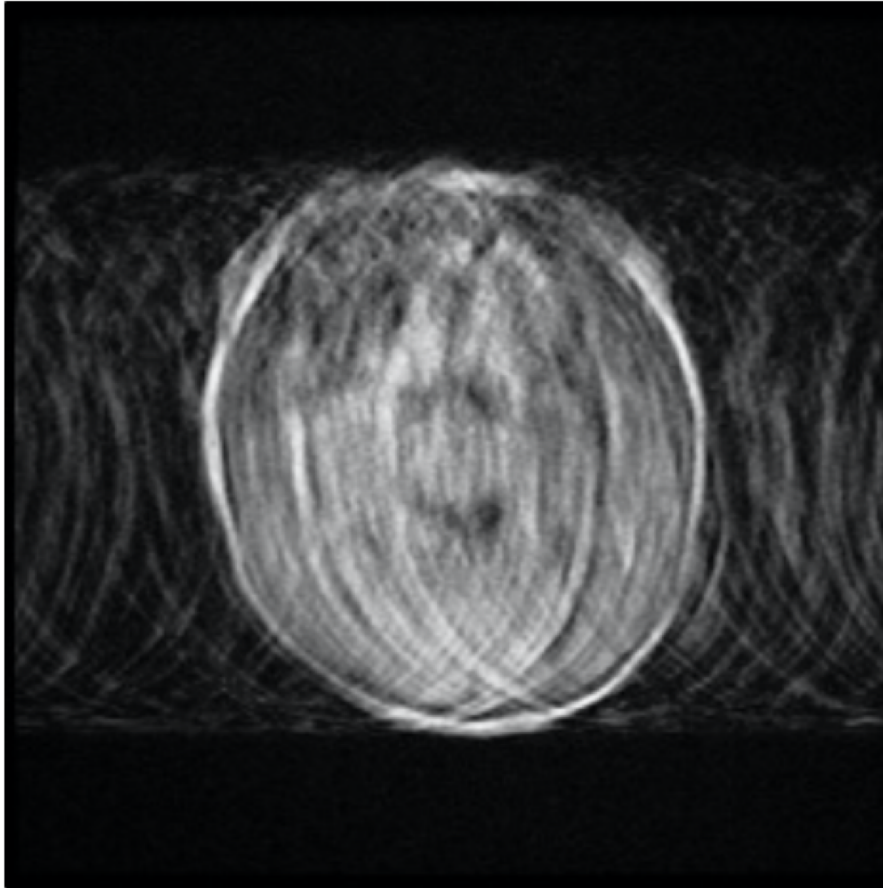


What kinds of images?

- Mostly brain MRI now (T1, T2, FLAIR, DWI/ADC)



Occasional scans are of poor quality



Approximately n=120 Non-Brain scans

- Mostly spine (n=99)
- Miscellaneous other MR (n=21)
- No way to consistently tell anything from file name

In addition there are MRS traces (n=2)





Identify Subjects / Request Data

Partners Biobank Portal

HIDE ▲

Enterprise-wide data for analysis or to give researchers through

A new initiative, the with Epic. The specific creating a distributed specific integration

The **Partners Biobank Portal** is a tool that links consented subjects from the **Partners Biobank** with their healthcare data from the electronic medical record (EMR) and allows researchers to request clinical samples for these subjects. Users must have a valid Partners logon and be a registered Research Patient Data Registry (RPDR) user to use the Portal.

In addition to comprehensive electronic medical record data, the Biobank Portal includes:

- **Biobank Health Information Survey**, patient-reported lifestyle, environment and family history information.
- **Curated Disease Populations** sets of subjects within the Biobank population who have been statistically determined to have a particular disease such as Type 2 diabetes, rheumatoid arthritis, congestive heart failure and others. These cohorts are often called disease phenotypes.
- **Healthy Populations**, an index that statistically groups patients by co-morbidities (using the Charlson Index) in order to help select relatively healthy controls from the Biobank population.
- **Biobank Sample Types**, including DNA, plasma and serum. Both de-identified and identified samples may be requested from the Portal. Requesting identified samples requires a valid Partners IRB protocol.
- **Biobank Genomic Data**, genotyped and imputed genomic data are available for a subset of the Biobank population and may be requested via the Portal. Both de-identified and identified samples may be requested from the Portal. Requesting identified samples requires a valid Partners IRB protocol.
- **Querying by Genomic Data**, single nucleotide polymorphism (SNP) and insertion and deletion (indel) variants and their related annotations are available on a subset of genotyped subjects in the Biobank Portal and may be used to query for subjects within the Portal.

Researchers can use the Biobank Portal to identify eligible case and control subjects, request samples, and perform analyses related to using consented samples for research.

Please contact the Biobankportalhelp@partners.org mailbox with any questions or support.

Biobank Portal Access

You must register to use the Biobank. If you are already an RPDR user, you are automatically registered.

- Request Access »
- Log in to the Biobank Portal »
- Biobank Portal Wiki »
- Help performing queries? Stacey Duey, (617) 759-8248 »
- Biobank Help Mailbox »

CONTACT BIOBANK SUPPORT »

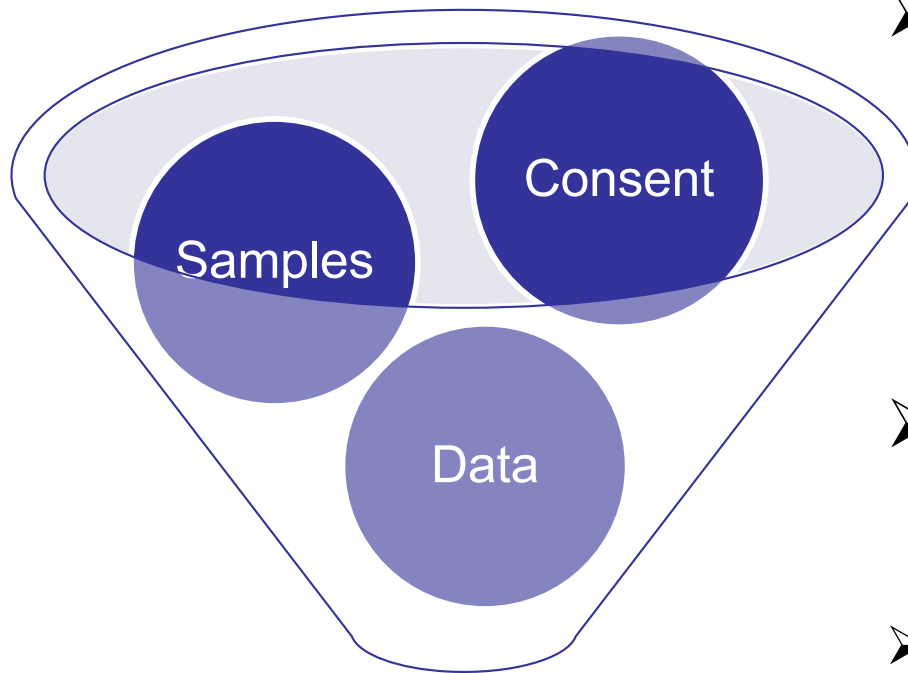
Research Pat
Research Patient D

RPDR Daily C
The RPDR has a ne

Partners Bio
Biobank Portal

mi2B2 Medic
mi2B2 Medical Im

The Partners Biobank



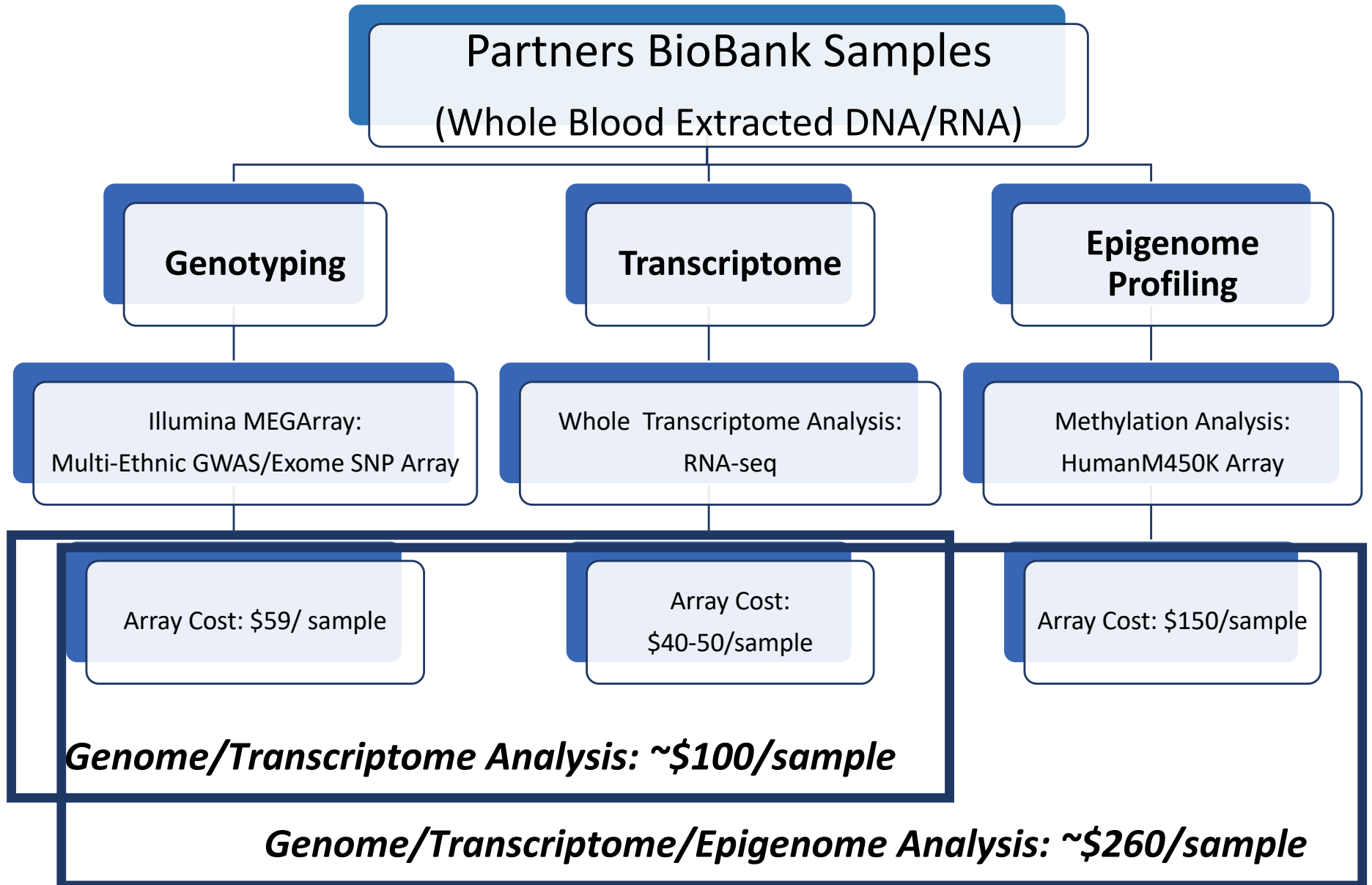
Research Discoveries

Improved Clinical Care for All Patients

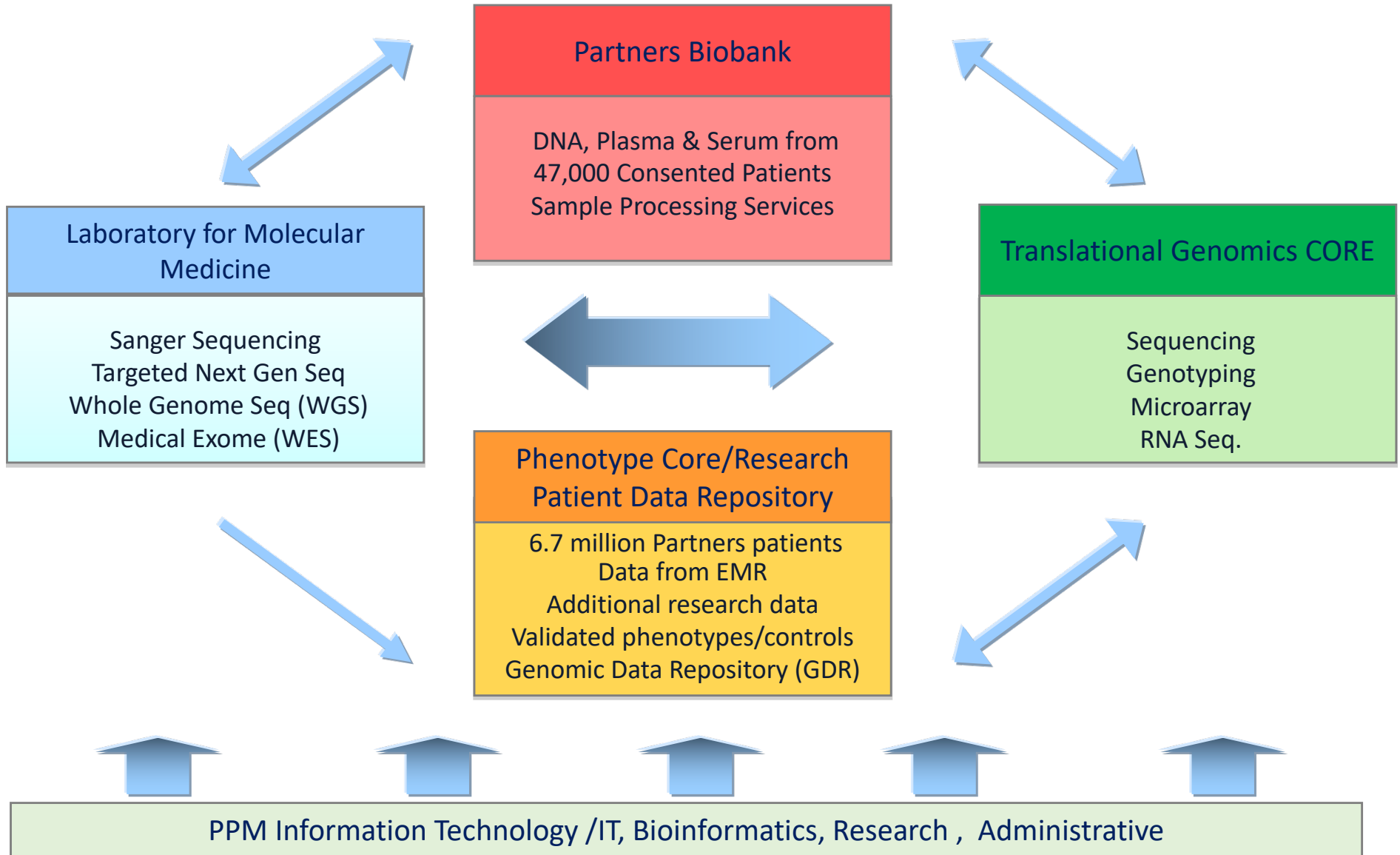
- The Partners Biobank provides samples (plasma, serum, and DNA) collected from consented patients.
- 80,000 patients have consented to date
- Samples are available for distribution to Partners investigators* to help identify novel Personalized Medicine opportunities that reduce cost and provide better care

**with required approval from the Partners Institutional Review Board (IRB).*

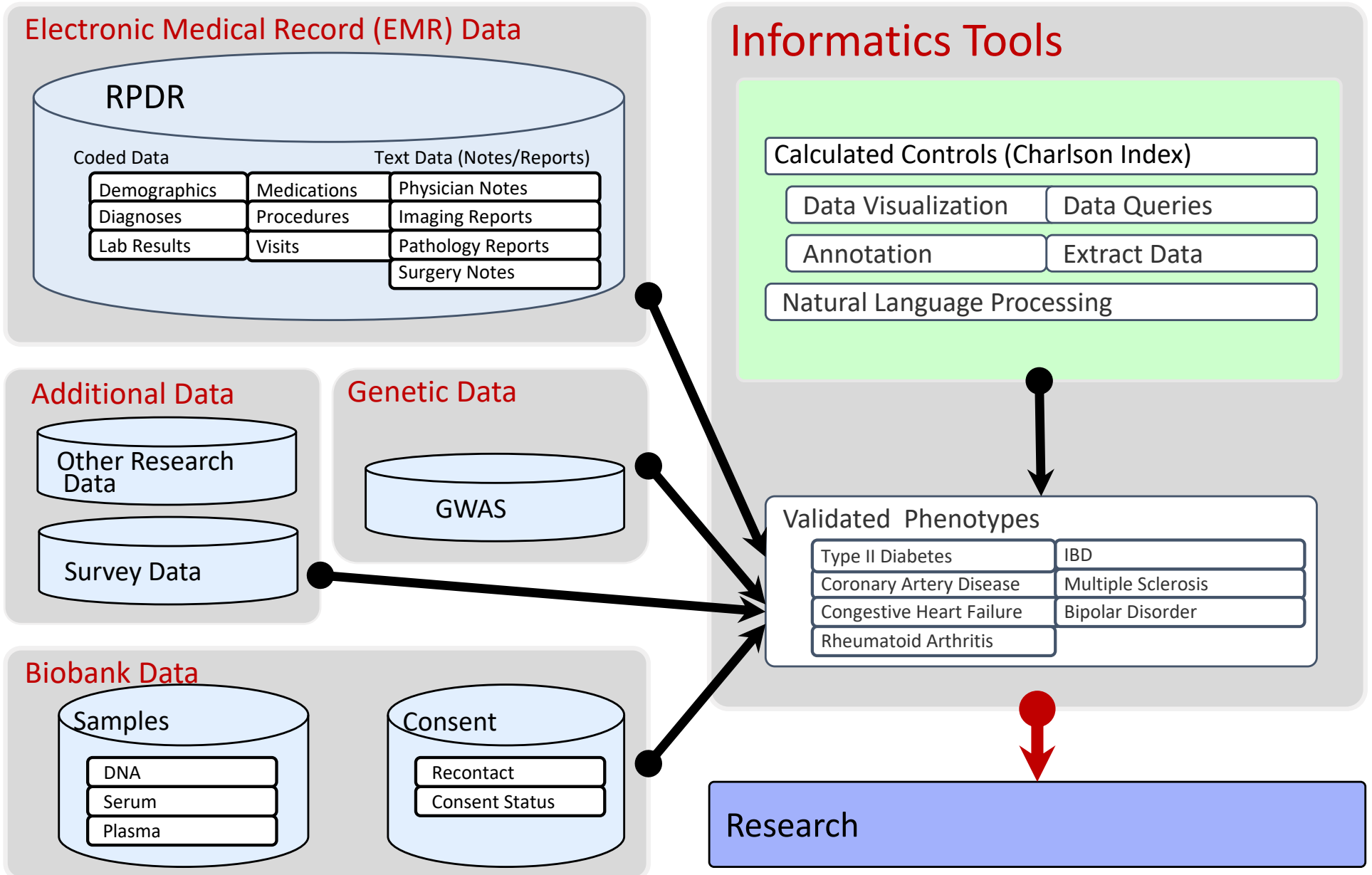
Biobank Integrative Genomics Strategy



Partners Personalized Medicine Components



Data Integration | Phenotype Discovery Center



Using electronic medical records to enable large-scale studies in psychiatry: treatment resistant depression as a model

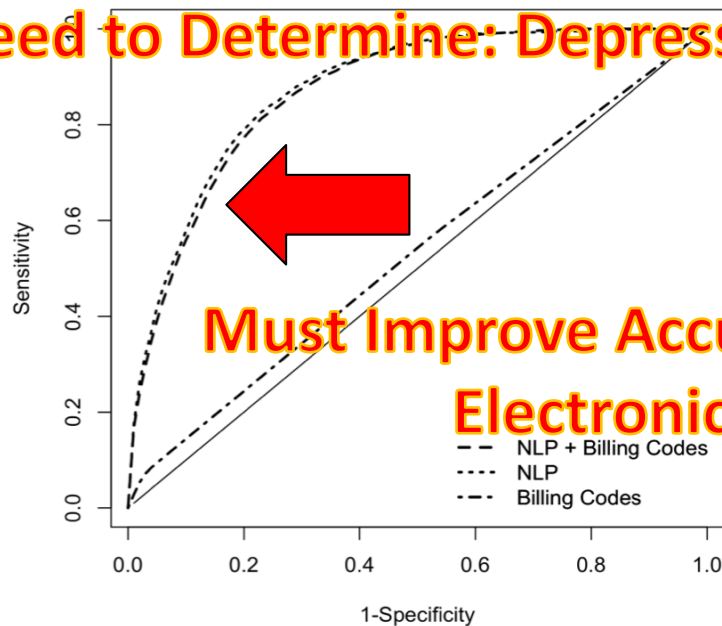
R. H. Perlis^{1,2*}, D. V. Iosifescu^{1,3}, V. M. Castro⁴, S. N. Murphy⁵, V. S. Gainer⁴, J. Minnier⁶, T. Cai⁶, S. Goryachev⁴, Q. Zeng⁷, P. J. Gallagher², M. Fava¹, J. B. Weilburg¹, S. E. Churchill⁸, I. S. Kohane⁹ and J. W. Smoller²

Use Phenotyping Algorithms to define cohorts of treatment-resistant and treatment-responsive depression

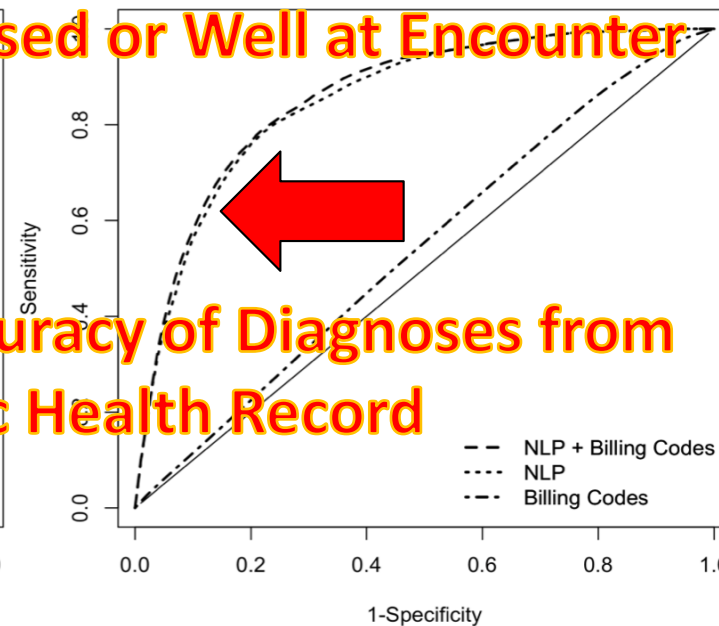
Need to Determine: Depressed or Well at Encounter

Initially:
AUC = 0.54

Finally:
AUC = 0.87



Must Improve Accuracy of Diagnoses from Electronic Health Record



Initially:
AUC = 0.55

Finally:
AUC = 0.86

Clinical Status	Model	Specificity	Sensitivity	Precision	AUC
Depressed	Billing Codes	0.95	0.09 (0.03)	0.57 (0.14)	0.54 (0.02)
Depressed	NLP	0.95	0.42 (0.05)	0.78 (0.02)	0.88 (0.02)
Depressed	NLP + Billing Codes	0.95	0.39 (0.06)	0.78 (0.02)	0.87 (0.02)
Well	Billing Codes	0.95	0.06 (0.02)	0.26 (0.27)	0.55 (0.03)
Well	NLP	0.95	0.37 (0.06)	0.86 (0.02)	0.85 (0.02)
Well	NLP + Billing Codes	0.95	0.39 (0.07)	0.85 (0.02)	0.86 (0.02)

Biobank Portal | Curated Diseases w/genotype data

Validated Phenotype	Count*	Predictive Positive Value
Bipolar Disease	154	89%
Congestive Heart Failure	556	90%
Coronary Artery Disease	3476	97%
Crohn's Disease	566	90%
Multiple Sclerosis	190	90%
Rheumatoid Arthritis	885	90%
Type 2 Diabetes Mellitus	2712	97%
Ulcerative Colitis	392	90%

Healthy Controls based on Charlson Index	Count*
0 – 10-year survival probability is >98.3%	12,142
1 – 10-year survival probability is >95.87%	8,556
2 – 10-year survival probability is >90.15%	8,250

* Based on 20,086 patients

** Based on 79,834 patients

Navigate Terms

Find

- [-] Biobank Consent Information i
- [-] Biobank Demographics
- [-] Biobank Genomics i
 - [-] People with genomic data - 4930
 - Illumina Multi-Ethnic GWAS/Exome SNP Array - 4930
- [-] Biobank Health Information Survey i
- [-] Biobank Sample Types i
- [-] Curated Disease Populations i
 - [-] Bipolar Disorder (BD) i
 - [-] Congestive Heart Failure (CHF) i
 - [-] Coronary Artery Disease (CAD) i
 - [-] Crohn's Disease (CD) i
 - [-] Multiple Sclerosis (MS) i
 - [-] Rheumatoid Arthritis (RA) i
 - RA - current or past history (PPV 0.90) - 717
 - RA - no history (NPV 0.99) - 24086
 - [-] Type 2 Diabetes Mellitus (T2DM) i
 - [-] Ulcerative Colitis (UC) i
- [-] Healthcare Data i
- [-] Healthy Populations (Controls) i

Query Tool

Query Name: RA - -Adali-Illum@15:46:12

Temporal Constraint:

Treat all groups independently

Group 1			Group 2			Group 3		
Dates	Occurs > 0x	Exclude	Dates	Occurs > 0x	Exclude	Dates	Occurs > 0x	Exclude
Treat Independently			Treat Independently			Treat Independently		
RA - current or past history (PPV 0.90) - 717			Adalimumab - 689			Illumina Multi-Ethnic GWAS/Exome SNP Array - 4930		

Run Query

Clear

3 Groups

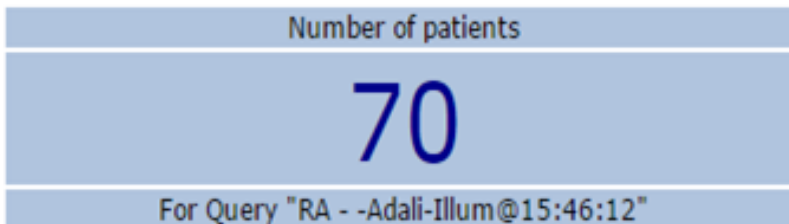
New Group

Show Query Status

Graph Results

Query Report

Download Data



Genotype Data

Search by Gene

Use the gene name box to specify the variant for which to search. When you begin typing in the search box below, a selection list will appear after you type the first characters.

Gene Name*: APO

Please note the zygosity of a particular variant (homozygous or heterozygous) to query for patients without a particular variant (heterozygous).

Zygoty*: APOA1, APOA1BP, APOA2, APOA4, APOA5, APOB, APOBEC1, APOBEC2, APOBEC3A, APOBEC3A_B, APOBEC3B

Consequence:

OK Cancel

Search by dbSNP rs Identifier

Use the rs identifier box to specify the variant for which to search. When you begin typing in the search box below, a selection list will appear after you type the first three numbers.

rs identifier*: rs1234

Please note the zygosity of a particular variant (homozygous or heterozygous) after you start typing (nucleotide on the right) to query for patients without a particular variant (heterozygous) that appears in the box on the left) to the alternate

Zygoty*: rs12340061 | G to A, rs12340067 | C to T, rs12340088 | T to G, rs12340105 | A to C, rs12340107 | G to T, rs12340117 | G to A, rs12340120 | G to A, rs12340129 | A to G, rs12340149 | G to A, rs12340158 | T to A

OK Cancel

LDLR

- 141 SNP or indels (V1)
- 243 SNP or indels (V2)
- 1336 subjects with protein altering (frameshift, missense, nonsense, start loss, stop loss) variant

High Quality Phenotypes for Genetic Studies

The screenshot displays the Partners Biobank Portal interface. On the left is a 'Navigate Terms' sidebar with a tree view of categories including Biobank Genomics, Curated Disease Populations, and various medical conditions. The main area is the 'Query Tool' with the following details:

- Query Name:** Prima-CHF --Gene@14:22:40
- Temporal Constraint:** Treat all groups independently
- Group 1:** Primary dilated cardiomyopathy - 4002
- Group 2:** CHF - current or past history (PPV 0.90) - 700
- Group 3:** Gene [contains "TTN AND Homozygous AND (Frameshift OR missense OR nonsense OR start_loss OR stop_loss)"]

The groups are connected by 'AND' operators, and each group has a 'one or more of these' indicator. Below the query tool, there are buttons for 'Run Query', 'Clear', and 'New Group'. At the bottom, a 'Graph Results' tab is active, showing a summary box:

Number of patients
70
For Query "Prima-CHF --Gene@14:22:40"

Acknowledgements

RPDR

- Shawn N Murphy
- Christopher Herrick
- Mariah Mitchell
- Stacey Duey
- Laurie Bogosian
- Eugene Braunwald
- Anne Klibanski
- Henry Chueh



Mi2b2

- Randy L Gollub
- Shawn N Murphy
- Christopher Herrick
- Bill Wang
- David Wang
- Kathy Andriole
- Darren Sack
- P Ellen Grant
- Nathaniel Reynolds
- Kallirroi Retzepi
- Rudolph Pienaar
- Victor Castro
- Steve Pieper
- Lilla Zollei
- Yangming Ou

CIB

- Shawn N Murphy
- Randy L Gollub
- Vivian Gainer
- Andrew Cagan
- Nich Wattanasin
- Christopher Herrick
- Bill Wang
- Reeta Metta
- Rudolph Pienaar
- Yangming Ou



Partners Healthcare, NIH/NCBC; /NIMH; /NCBI; /NCATS; /NIBIB
NIH RO1 EB014947
NIH R01 AT006364
NIH R01 AT005280
NIH P01 AT006663

Operating the mi2b2 Workbench

The user inputs the passphrase associated with the IRB protocol of the institution in order to access the workbench.

The user can enter a list of MRNs specific to a patient cohort in order to access information from only those studies.

The user requests them from PACS by clicking on the "Move to Image Repository" button.

Repository Usage: 0.16%

Displaying 369/369 patients(s)

Displaying 4/369 patients(s)

Displaying 4/4 study(ies)

Accession #	Report	Institution	MRN	Study Date	Modalities	Description	Department
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	BWH			Computed Radio...	BWH CT VAS...	Radiology
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	BWH			Computed Radio...	BWH CT CHE...	Radiology
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	BWH			Computed Radio...	BWH CT MSK...	Radiology
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	BWH			Computed Radio...	BWH XR BON...	Radiology

Selection
 Not Checked
 Checked

Accession #
Type in values you want to retain. Leave blank to retain all values. Values are delimited by blank space, comma, or carriage return.
Apply Filter

Report
 Report Available

Institution
 BWH

MRN
blank to retain all values. Values are delimited by blank space, comma, or carriage return.
Apply Filter

Study Date

Move to Image Repository

Operating the mi2b2 Workbench

The user now has to wait for all of the requested material to be retrieved from PACS into the project-specific mi2b2 repository. Once this happens, all studies' status will be set to Completed in the Transferred Images tab.

The screenshots illustrate the workflow in the mi2b2 Workbench:

- Top Screenshot:** Shows the 'Submitted Requests' table with columns for Request ID, Status, Institution, MRN, Accession #, Priority, Request Date, Modalities, and Request ID. The 'Transfer Log' tab is highlighted in red.
- Middle Screenshot:** Shows the 'Transferred Images' tab with a table of studies in the repository. The 'Delete Selected from Repository' button is highlighted in red.
- Bottom Screenshot:** Shows the 'Image Viewer' tab displaying a medical image of a knee joint. The 'Image Viewer' tab is highlighted in red.

The interface includes various controls such as 'Select All', 'Flip Selections', 'Cancel', 'Delete', 'Resubmit', 'Change Priority to:', 'Apply', 'Refresh', and 'Toggle Filters'. The status of requests and studies is updated as they are processed.

The Transferred Images tab displays the project's repository, which houses the studies that correspond to completed requests. In order to view them the user has to download them to a local machine.