

i2b2 Roadmap

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I2b2 Roadmap

- 1 – Supporting cohort discovery and recruitment “out of the box” for clinical and observational trials.
- 2 – Supporting future query systems either outside of the Data Repository or within NoSQL systems.
 - Imaging
 - Genomics
 - Text / Unstructured data
- 3 – Supporting add-on plug-ins, web services, and ETL processes

Supporting cohort discovery and recruitment

■ First - Allow Manager to obtain Identified Patient Sets

- First step in creating a new data mart
- Patient MRNs can be obtained through Workbench or through Identity Management Cell for Web Client
- Assumes Patient Mapping table contains the list of encrypted MRNs mapped to i2b2 patient numbers (could be plain text MRNs depending on site policy)

Working with patient sets – Patient Set Viewer

The screenshot displays the i2b2 Workbench interface for managing patient sets. The main window is titled "i2b2 Workbench for i2b2demodata2" and shows the user "wensong1" with a status of "i2b2".

Left Panel:

- Navigate:** Shows a tree view with folders "demo", "lcp5", and "wp1".
- Search By Name:** Includes a "Containing" dropdown, a text input field, a "Find" button, and an "Any Category" dropdown.
- Previous Queries:** Shows a list of queries, including "Diagnoses@09:53:22 [03-18-2013] [wp1]".
- Patient Set:** Displays a list of patient sets, including "Results of Diagnoses@09:53:22" and "Patient Set for 'Diagnoses@09:53:22'".

Right Panel:

- Query Tool:** Contains three groups (Group 1, Group 2, Group 3) for defining queries. Each group has tabs for "Dates", "Occurs > 0x", and "Exclude", and a "Treat Independently" dropdown. Instructions below each group state: "Drag terms from Navigate, Find and Workplace into this group".
- Analysis Types:** A list of analysis types with checkboxes: "Patient set", "Encounter set", "Number of patients" (checked), "Gender patient breakdown", and "Vital Status patient breakdown".
- Query Timing:** Includes a "Treat all groups independ" checkbox and a "Selected groups occur in" dropdown.
- Buttons:** "Get Everyone", "Run Query Above", and "Patient(s) returned:".

Bottom Panel:

- Patient Set Identifier:** A text input field.
- Table:** A table with columns "HIVE", "Patient Set Identifier", and "Patient(s) returned:". The table is currently empty.
- Buttons:** "Save", "Import", and "Convert File".

Drag single or sets of patients into View

The screenshot displays the i2b2 Workbench interface for the i2b2demodata2 database. The top menu bar includes File, Window, and Help. The main toolbar contains buttons for Navigat, Find Te, Workpla, Find in, and Query Tool. The left sidebar shows a tree view of the database structure, including folders like demo, lcp5, and wp1. Below this is a search bar with a 'Search By Name' dropdown and a 'Find' button. The main workspace is divided into several panels. The top panel, 'Query Tool', shows a 'Query Name' field and three groups of settings for 'Group 1', 'Group 2', and 'Group 3'. Each group has options for 'Dates', 'Occurs > 0x', and 'Exclude'. Below these are 'Treat Independently' dropdowns and instructions to 'Drag terms from Navigate, Find and Workplace into this group'. The bottom of the Query Tool panel has a 'Get Everyone' checkbox and a 'Run Query Above' button. The right panel, 'Analysis Types', lists various analysis options like 'Patient set', 'Encounter set', 'Number of patients', 'Gender patient breakdown', 'Vital Status patient breakdown', and 'Race patient breakdown'. It also includes a 'Query Timing' section with options for 'Treat all groups independent' and 'Selected groups occur in'. The bottom panel, 'Patient Set Viewer', shows a table of patient data. The table has columns for HIVE, BWH, MGH, NWH, NSMC_SALEM, NSMC_UNION, EMP, BWI, FH, and DFC. The data is organized into rows, with some rows highlighted in blue. The bottom of the Patient Set Viewer panel has buttons for 'Save', 'Import', and 'Convert File'.

Query Tool

Query Name: []

Group 1: Dates, Occurs > 0x, Exclude, Treat Independently

Group 2: Dates, Occurs > 0x, Exclude, Treat Independently

Group 3: Dates, Occurs > 0x, Exclude, Treat Independently

Drag terms from Navigate, Find and Workplace into this group

Get Everyone Run Query Above Patient(s) returned: []

Analysis Types

- ☐ Patient set
- ☐ Encounter set
- ☒ Number of patients
- ☐ Gender patient breakdown
- ☐ Vital Status patient breakdown
- ☐ Race patient breakdown

Query Timing

- ☒ Treat all groups independent
- ☐ Selected groups occur in

Patient Set Viewer

Patient Set Identifier: "Diagnoses@09:53:22"

HIVE	BWH	MGH	NWH	NSMC_SALEM	NSMC_UNION	EMP	BWI	FH	DFC
1000000001									
1000000002									
1000000003									
1000000004									
1000000005									
1000000006									
1000000007									
1000000008									
1000000009									
1000000010									
1000000011									
1000000012									
1000000013									
1000000014									
1000000015									
1000000016									
1000000017									
1000000018									
1000000019									
1000000020									
1000000021									
1000000022									
1000000025	15783376	3000001845	4000002025	S500003075	U500004035	101809330	01800290		
1000000026	17028580		4000002026	S500003076	U500004036	102344360	01954309	00001003	252304
1000000027	2000001987	3000001847		S500003077	U500004037	103943507			
1000000028	17028598	3000001848	4000002028	S500003078	U500004038	102344362	01954310		252305
1000000029	2000001989	3000001849	4000002029	S500003079	U500004039				
1000000030	2000001990	3000001850	4000002030	S500003080	U500004040				
1000000031	2000001991	3000001851	4000002031	S500003081	U500004041				
1000000032	2000001992	3000001852	4000002032	S500003082	U500004042				
1000000033	17028630	3000001853	4000002033	S500003083	U500004043	102344364	01954385		252307
1000000034	2000001994	3000001854	4000002034	S500003084	U500004045				
1000000035		3000001855	4000002035	S500003085	U500004046				
1000000036	2000001996		4000002036	S500003086	U500004047	102344367	01954387		252309
1000000037	17028655	3000001857		S500003087	U500004048				
1000000038	2000001998	3000001858	4000002038	S500003088	U500004049	102344369	01954124		252310
1000000039	17028473	3000001859	4000002039	S500003089	U500004050				
1000000040	2000002000	3000001860	4000002040	S500003090	U500004051				
1000000041	2000002001	3000001861	4000002041	S500003091	U500004052				
1000000042	2000002002	3000001862	4000002042	S500003092	U500004053				

Save Import Convert File

i2b2 Workbench

File Window Help

i2b2 Workbench for i2b2demodata2 wensong1 Status: i2b2

Query Tool

Query Name:

Group 1 Group 2 Group 3

Dates Occurs > 0x Exclude Dates Occurs > 0x Exclude Dates Occurs > 0x Exclude

Treat Independently Treat Independently Treat Independently

Drag terms from Navigate, Find and Workplace into this group

Analysis Types

☐ Patient set

☐ Encounter set

☒ Number of patients

☐ Gender patient breakdown

☐ Vital Status patient breakdown

Query Timing

☒ Treat all groups independently

☐ Selected groups occur in

Run Query Above

Patient(s) returned:

Timeline View Analysis View Patient Set Viewer

Patient Set Identifier: "Diagnoses@09:53:22"

HIVE	BWH	MGH	NWH	NSMC_SALEM	NSMC_UNION	EMP	BWI	FH	DFC
1000000025	15783376	3000001845	4000002025	5500003075	U500004035	101809330	01800290		
1000000026	17028580		4000002026	5500003076	U500004036	102344360	01954309	00001003	252304
1000000027	2000001987	3000001847		5500003077	U500004037	103943507			
1000000028	17028598	3000001848	4000002028	5500003078	U500004038	102344362	01954310		252305
1000000029	2000001989	3000001849	4000002029	5500003079	U500004039				
1000000030	2000001990	3000001850	4000002030	5500003080	U500004040				
1000000031	2000001991	3000001851	4000002031	5500003081	U500004041				
1000000032	2000001992	3000001852	4000002032	5500003082	U500004042				
1000000033	17028630	3000001853	4000002033		U500004043	102344364	01954385		252307
1000000034	2000001994	3000001854	4000002034	5500003084					
1000000035		3000001855	4000002035	5500003085	U500004045				
1000000036	2000001996		4000002036	5500003086	U500004046				
1000000037	17028655	3000001857		5500003087	U500004047	102344367	01954387		252309
1000000038	2000001998	3000001858	4000002038	5500003088	U500004048				
1000000039	17028473	3000001859	4000002039	5500003089	U500004049	102344369	01954124		252310
1000000040	2000002000	3000001860	4000002040	5500003090	U500004050				
1000000041	2000002001	3000001861	4000002041	5500003091	U500004051				
1000000042	2000002002	3000001862	4000002042	5500003092	U500004052				

Save Import Convert File

Drag

Patient Sets are first-class objects (like queries)

- Patients are first-class objects and can be used in queries and grouped together in Workplace Cell
- Patient Mapping table can manage groups of patients for projects in one database

Patient is a first-class object

The screenshot displays the i2b2 Workbench interface for the i2b2demodata2 database. The top bar shows the user 'wensong1' and the status 'i2b2'. The main window is divided into several panes:

- Left Pane (Navigation):** A tree view showing the database structure. The 'demo' folder is expanded, showing 'wp1' which contains a list of patient IDs and names, including 'PATIENT MGH:3000001849'.
- Top Center Pane (Query Tool):** A tabbed interface for creating queries. It shows three groups (Group 1, Group 2, Group 3) with fields for 'Dates', 'Occurs > 0x', and 'Exclude'. A patient ID 'PATIENT MGH:3000001849' is added to Group 1. The 'Analysis Types' panel on the right shows 'Number of patients' selected.
- Bottom Left Pane (Patient Set):** A search interface with a 'Search By Name' field and a 'Find' button. Below it, a list of patient sets is shown, including 'Diagnoses@09:53:22' and 'Patient Set for "Diagnoses@09:53:22"'. The patient set for 'Diagnoses@09:53:22' is expanded, showing a list of patient IDs and names.
- Bottom Center Pane (Patient Set Viewer):** A table displaying the results of the query. The table has columns for patient IDs and names, and a 'Patient Set Identifier' field set to 'Diagnoses@09:53:22'.

HIVE	BWH	MGH	NWH	NSMC_SALEM	NSMC_UNION	EMP	BWI	FH	DFC
1000000025	15783376	3000001845	4000002025	5500003075	U500004035	101809330	01800290		
1000000026	17028580		4000002026	5500003076	U500004036	102344360	01954309	00001003	252304
1000000027	2000001987	3000001847		5500003077	U500004037	103943507			
1000000028	17028598	3000001848	4000002028	5500003078	U500004038	102344362	01954310		252305
1000000029	2000001989	3000001849	4000002029	5500003079	U500004039				
1000000030	2000001990	3000001850	4000002030	5500003080	U500004040				
1000000031	2000001991	3000001851	4000002031	5500003081	U500004041				
1000000032	2000001992	3000001852	4000002032	5500003082	U500004042				
1000000033	17028630	3000001853	4000002033		U500004043	102344364	01954385		252307
1000000034	2000001994	3000001854	4000002034	5500003084					
1000000035		3000001855	4000002035	5500003085	U500004045				
1000000036	2000001996		4000002036	5500003086	U500004046				
1000000037	17028655	3000001857		5500003087	U500004047	102344367	01954387		252309
1000000038	2000001998	3000001858	4000002038	5500003088	U500004048				
1000000039	17028473	3000001859	4000002039	5500003089	U500004049	102344369	01954124		252310
1000000040	2000002000	3000001860	4000002040	5500003090	U500004050				
1000000041	2000002001	3000001861	4000002041	5500003091	U500004051				
1000000042	2000002002	3000001862	4000002042	5500003092	U500004052				

At the bottom of the interface, there is a status bar that reads 'Retrieving information on this item ...'.

Creating computation Patient Sets from patients

Add Patients to the Query Tool

The screenshot displays the 'Query Tool' window. At the top, there is a 'Query Name' field. Below it, three groups are defined: Group 1, Group 2, and Group 3. Each group has a 'Dates' field, an 'Occurs > 0x' field, and an 'Exclude' field. Group 1 is currently populated with two patient IDs: 'PATIENT HIVE:1000000011' and 'PATIENT MGH:3000001863'. Each group also has a 'Treat Independently' dropdown menu. To the right of the groups is a vertical 'Add Group' button. On the far right, there is a panel for 'Analysis Types' with checkboxes for 'Patient Set', 'Encounter Set', 'Number of patients' (checked), 'Gender patient breakdown', 'Vital Status patient breakd', 'Race patient breakdown', 'Age patient breakdown', and 'Timeline' (checked). Below this is a 'Query Timing' section with radio buttons for 'Treat all groups indepen' (selected), 'Selected groups occur in', and 'Items Instance will be sa'. At the bottom, there is a 'Get Everyone' button, a 'Run Query Above' button, and a 'Patient(s) returned:' field.

Group 1	Group 2	Group 3
<input type="checkbox"/> Dates <input type="checkbox"/> Occurs > 0x <input type="checkbox"/> Exclude Treat Independently PATIENT HIVE:1000000011 PATIENT MGH:3000001863	<input type="checkbox"/> Dates <input type="checkbox"/> Occurs > 0x <input type="checkbox"/> Exclude Treat Independently	<input type="checkbox"/> Dates <input type="checkbox"/> Occurs > 0x <input type="checkbox"/> Exclude Treat Independently

Analysis Types

- ☐ Patient Set
- ☐ Encounter Set
- ☒ Number of patients
- ☐ Gender patient breakdown
- ☐ Vital Status patient breakd
- ☐ Race patient breakdown
- ☐ Age patient breakdown
- ☒ Timeline

Query Timing

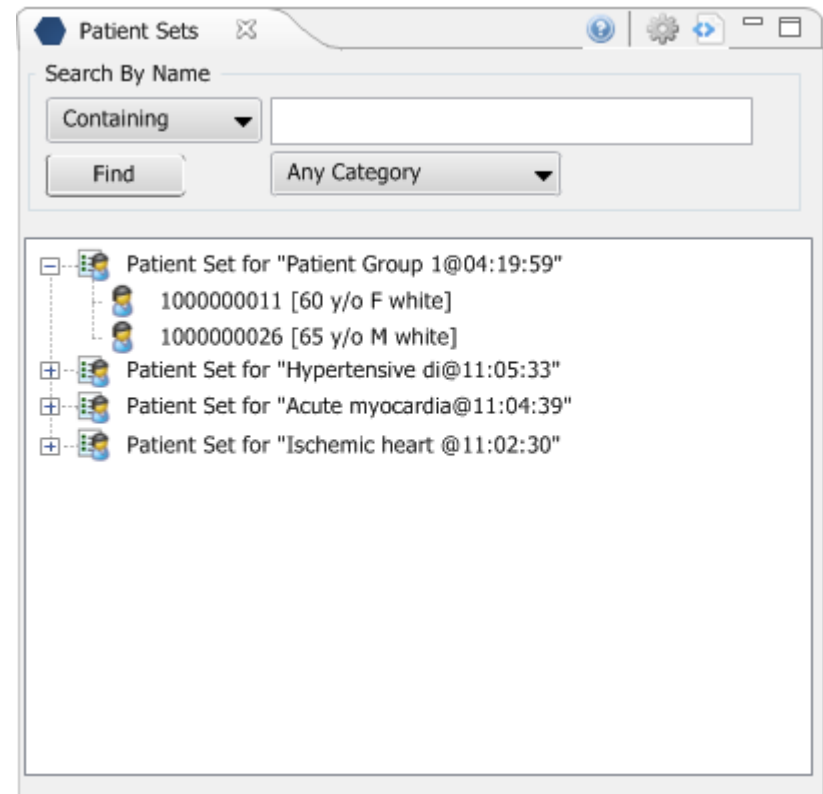
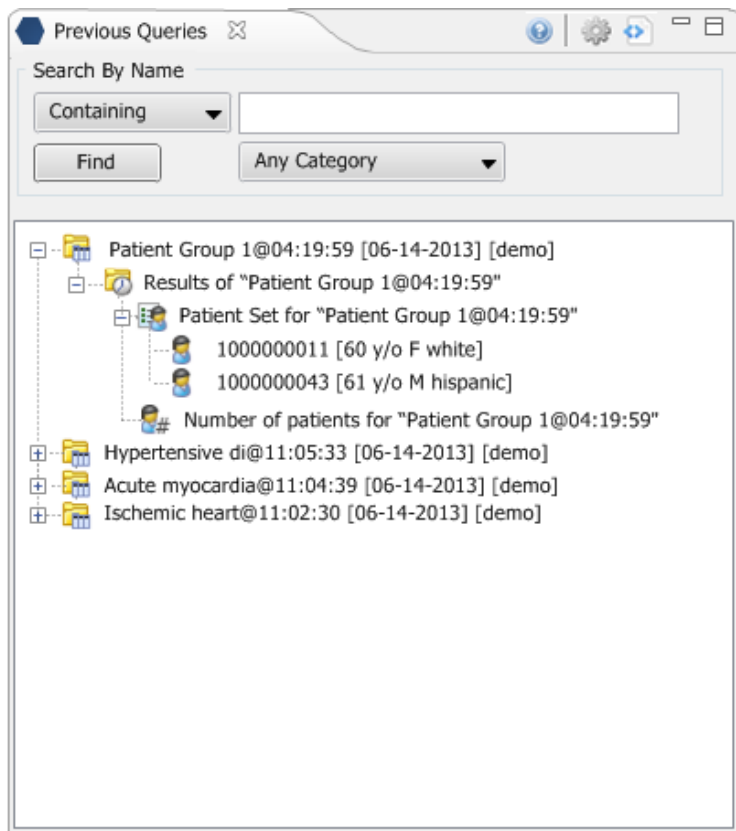
- ☒ Treat all groups indepen
- ☐ Selected groups occur in
- ☐ Items Instance will be sa

Get Everyone Run Query Above Patient(s) returned:

Run the Query . . .

Creating Patient Sets

New Patient Set appears in Previous Queries & Patient Sets Views



Patient Sets in mapping table are strategy to creating several projects in one database

- Patient Mapping table can manage groups of patients for projects in one database

Workflow to support Clinical Trials

- Person does query as obfuscated user in large data mart
- Optimal query results can be used to create request for approval so that patients can be viewed as a limited data set
- Approval is obtained and a new project is created where those patients in the Optimal patient set can be viewed in plug-ins such as timeline, charts, and de-identified SMART views.
- Patients are carefully screened in limited-data displays to sort into good candidate patients for the Clinical trial.
- PHI is viewed on the truly Optimal patients in a specially Audited view that resembles EMR
- PHI enables patients to be contacted through mechanisms that abide by hospital policy

Management of Projects

“demo” project has the following i2b2 patients

1000000001

1000000005

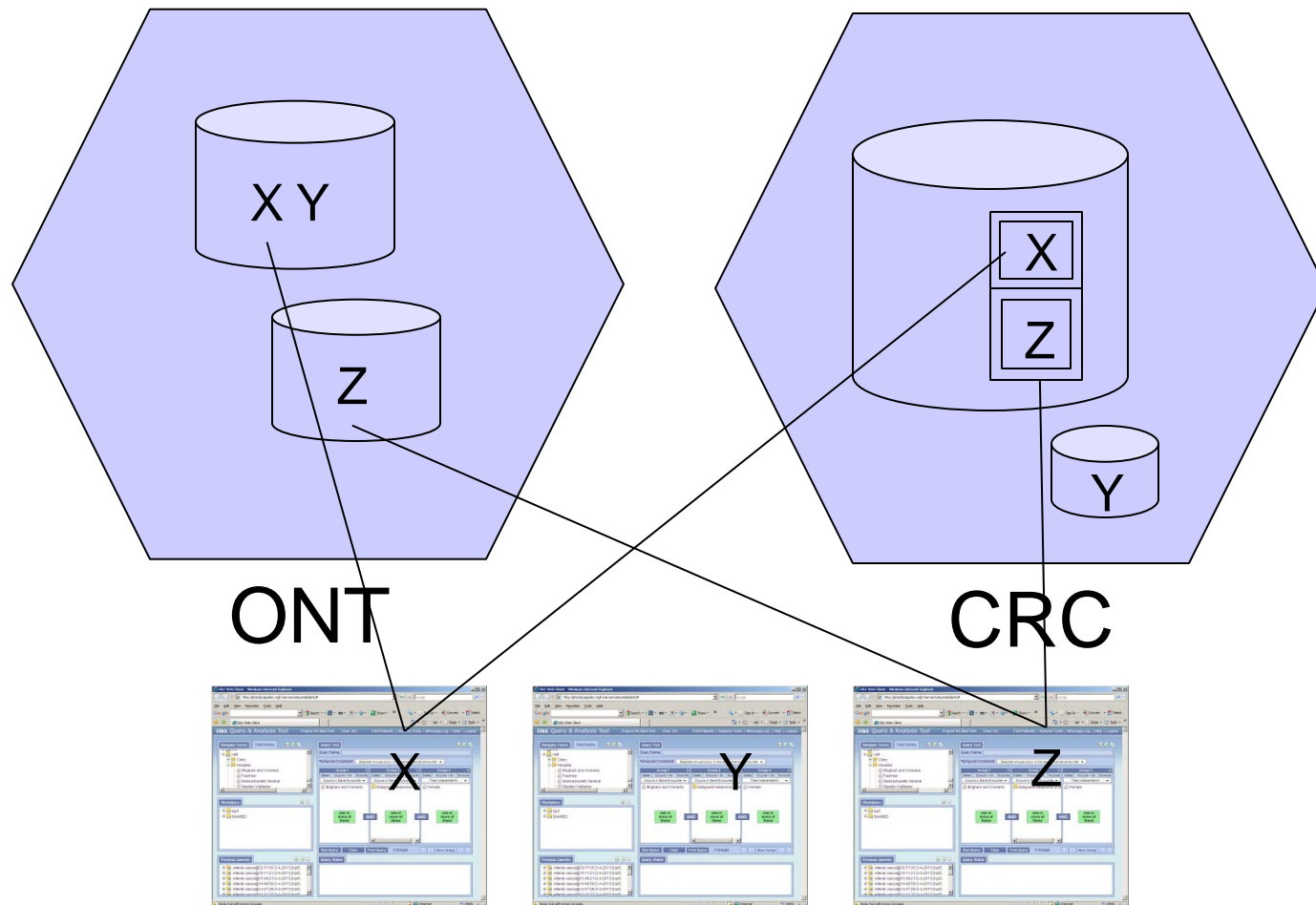
“demo2” project has the following i2b2 patients

1000000001

1000000126

* Patient number 1000000001 exists in both projects

Mix and match ontology tables and patient databases for various projects.



Patients in PATIENT_MAPPING table for the two projects called demo=X and demo2=Z

	PATIENT_IDE	PATIENT_IDE_SOURCE	PATIENT_NUM	PATIENT_IDE_STATUS	PROJECT_ID
1	2000001961	BWH	1000000001	A	demo
2	1000000001	HIVE	1000000001	A	demo
3	3000001821	MGH	1000000001	A	demo
4	2000001965	BWH	1000000005	A	demo
5	1000000005	HIVE	1000000005	A	demo
6	3000001825	MGH	1000000005	A	demo
7	2000001961	BWH	1000000001	A	demo2
8	1000000001	HIVE	1000000001	A	demo2
9	3000001821	MGH	1000000001	A	demo2
10	17028580	BWH	1000000026	A	demo2
11	1000000026	HIVE	1000000026	A	demo2
12	4000002026	NWH	1000000026	A	demo2

CT Web Client being developed by CBMI

i2b2 CT Query & Analysis Tool

Project: i2b2 Demo User: i2b2 User
[i2b2 Core](#) | [Analysis Tools](#) | [Help](#) | [Logout](#)

Filter Saved Queries

Query Name Ascending

Navigate Terms

Workplace

Saved & Run Queries

- [Crohn's disease study](#)
Last Modified: 10-12-2012
- [Children with diabetes](#)
Last Modified: 9-23-2012
- [7316cb3b-b7ee-45f5-90db-97054ad807cc](#)
Last Modified: 4-4-2012
- [8f4de438-85c7-436c-a3e8-6a4ea6a97284](#)
Last Modified: 4-25-2012
- [Female@18:54:13](#)
Last Modified: 7-12-2012
- [Childhood obesity study @1-17-2012 18:54:13](#)
Last Modified: 2-21-2012
- [Cancer study - 2005](#)
Last Modified: 1-17-2012
- [Cancer study - 2007](#)
Last Modified: 1-17-2012

New Load Crohn's disease study Save
**last saved 12/12/2012 1:00 pm*

Query Builder

Options and/or

Crohn's disease

OR

Options and/or

Options and/or

Ulcerative colitis OR Other ulcerative colitis

AND

Options and/or

adalimumab OR Infliximab OR certolizumab pegol

Query Action

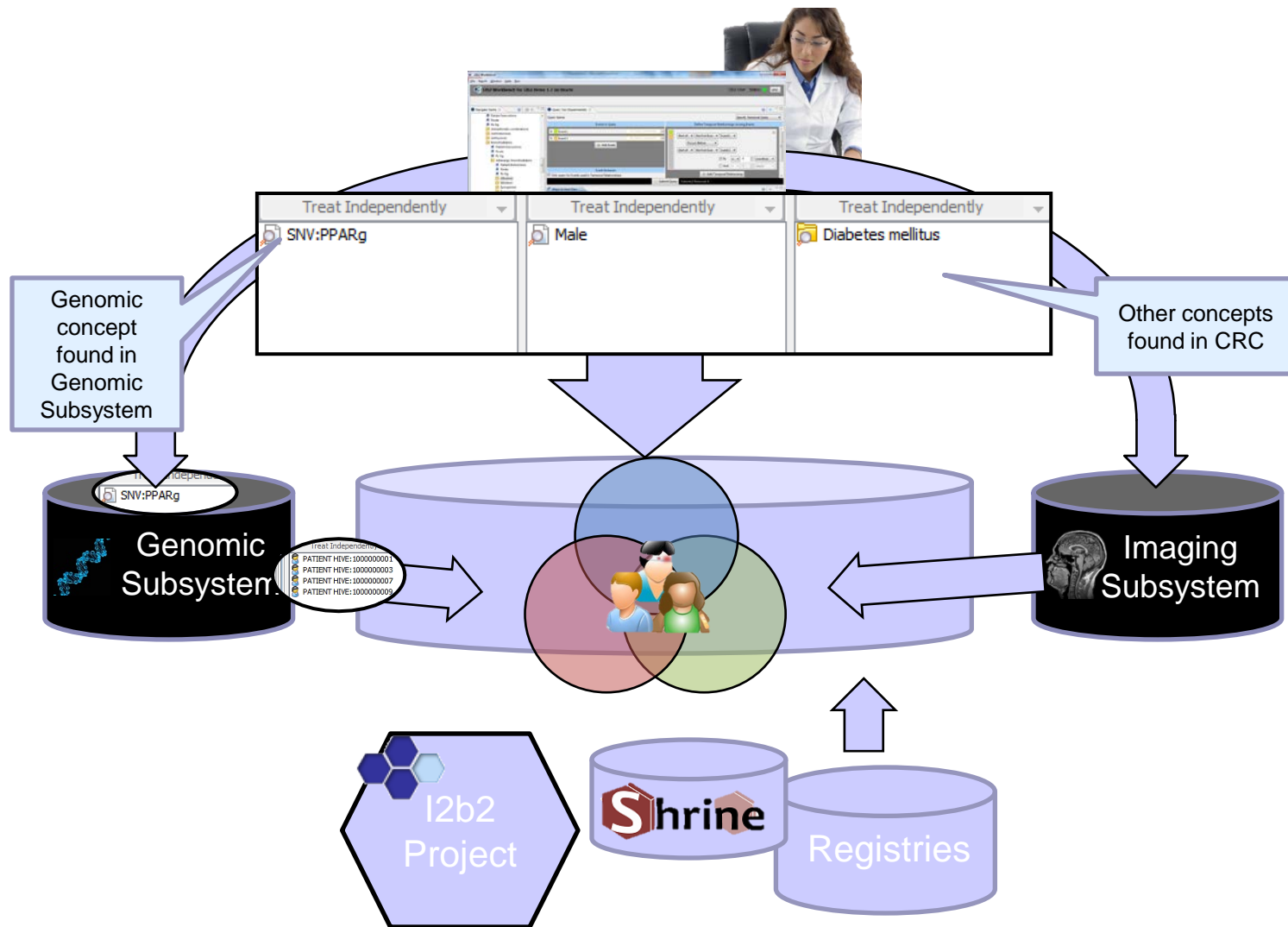
Run Query

Application Version: 1.14-SNAPSHOT revision: 8771 branch: trunk built on: 2012-09-06 15:33:52

Supporting Future Query Systems

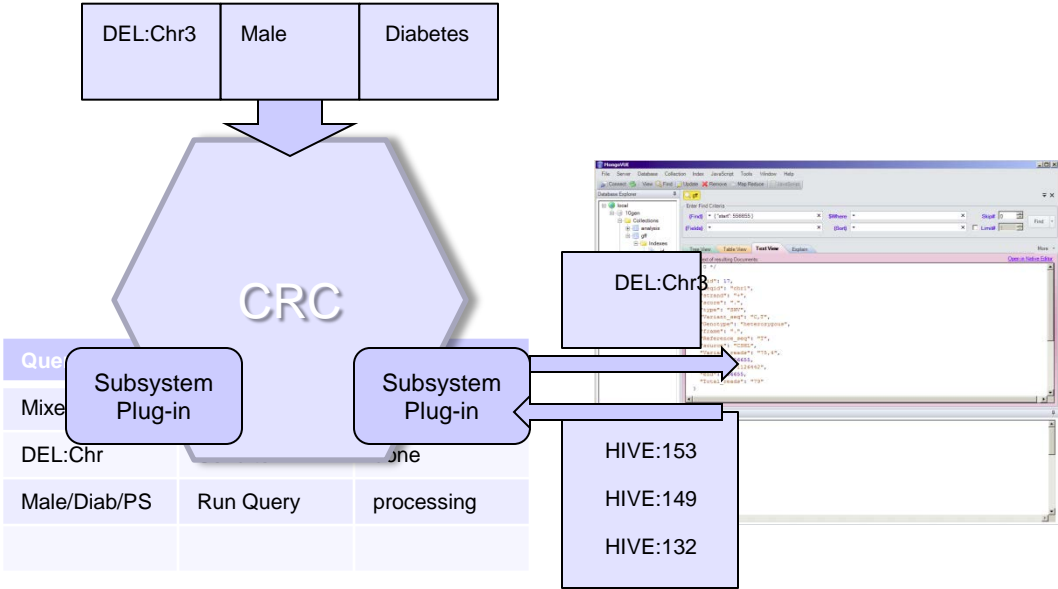
- Supporting future query systems either outside of Data Repository or NoSQL
 - Imaging
 - Genomics
 - Text / Unstructured data

Supporting Future Query Systems




Depends upon Patient Set Infrastructure

DICOM Archive




Depends on Ontology Management Tools

 BioPortal

[Browse](#) [Search](#) [Projects](#) [Annotate](#)

✕ SNOMED Clinical Terms

SNOMED Clinical Terms  [Subscribe to updates](#)

[Metadata](#) [Views \(8\)](#) [Projects \(1\)](#) [Reviews \(1\)](#) [Notes \(0\)](#) [Metrics](#) [Ontology Widgets](#)

[Create New View](#)

[Expand All](#) | [Collapse All](#)

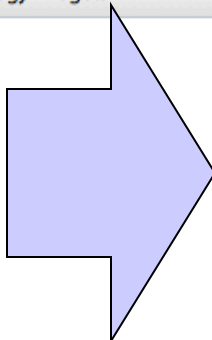
- ▶ **CORE Subset of SNOMED CT**
- ▶ **SNOMED Anatomy**
- ▶ **SNOMED Clinical Findings**
 - **Description:** The Clinical Finding subtree of SNOMED CT
 - **Definition:** Class subtree of ClinicalFinding
 - **Ontology ID:** 2018
 - **Definition Language:** Manual

VERSION	BASE VERSION	CREATED	CREATED BY
1.2	2009_07_31	07/16/2010	Tania Tudorache, tudorache@stanford.edu
1.1	2009_07_31	03/23/2010	Tania Tudorache, tudorache@stanford.edu
1.0	2009_01_31	09/09/2009	Tania Tudorache, tudorache@stanford.edu

- ▶ **SNOMED Ethnic Group**

Navigate Terms

- [-] Clinical finding
 - [+] Administrative statuses
 - [+] Adverse incident outcome categories
 - [+] Calculus finding
 - [+] Clinical history and observation findings
 - [+] Clinical stage finding
 - [+] Cyanosis
 - [+] Deformity
 - [+] Disease
 - [+] Drug action
 - [+] Edema
 - [+] Effect of exposure to physical force
 - [+] Enzyme activity finding
 - [+] Evaluation finding
 - [+] Fetal finding
 - [+] Finding by method
 - [+] Finding by site
 - [+] Finding of grade
 - [+] Finding related to physiologic substance
 - [+] Finding reported by subject or history provider
 - [+] General clinical state finding
 - [+] Jaundice
 - [+] Neurological finding
 - [+] Prognosis/outlook finding
 - [+] Sequelae of external causes and disorders
 - [+] Swelling
 - [+] Wound finding



[Sign In](#) [R](#)

[ALIZE](#)

[e](#)

[e](#)

[e](#)

i2b2 Web Client

Installation x i2b2 Web Client x Phillips, Lori C. - Outlook Web ... x Capture a Screen Shot with Mac... x

phsi2b2appdev.mgh.harvard.edu/webclient/

i2b2 Query & Analysis Tool Project: i2b2 Demo User: i2b2 User Find Patients | Analysis Tools | Message Log | Help | Logout

Navigate Terms Find Terms

- SO VARIANTS
 - copy_number_variation
 - deletion
 - indel
 - insertion
 - inversion
 - structural_alteration
 - substitution
 - translocation
 - Upd

Workplace

- demo
- SHARED

Query Tool

Query Name:

Temporal Constraint:

Group 1		Group 2		Group 3	
Dates	Occurs > 0x	Dates	Occurs > 0x	Dates	Occurs > 0x
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Sequence_alteration

- deletion
- insertion
 - duplication
 - novel_sequence_insertion
- indel
- inversion
- SNV
 - SNP
- substitution
 - MNP
- translocation
- Copy_number_variant
- UPD

Previous Queries

- substitution@01:44:09 [11-15-2012] [demo]
- substitution@01:39:20 [11-15-2012] [demo]
- substitution@01:38:57 [11-15-2012] [demo]
- Test_%[bracket]@10:14:00 [11-15-2012] [demo]
- substitut-substit@10:55:38 [11-14-2012] [demo]
- substitution@14:09:30 [11-13-2012] [demo]

Query Status

Enables Data flow of next-gen sequencing



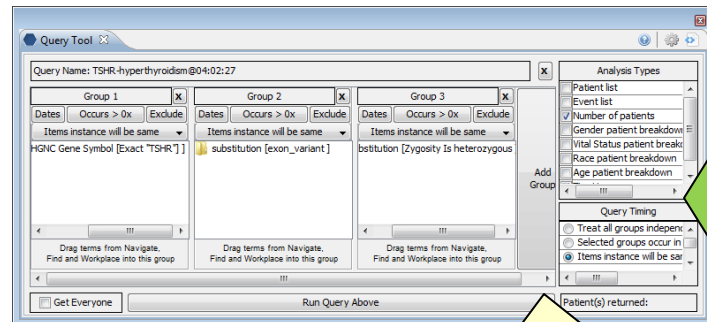
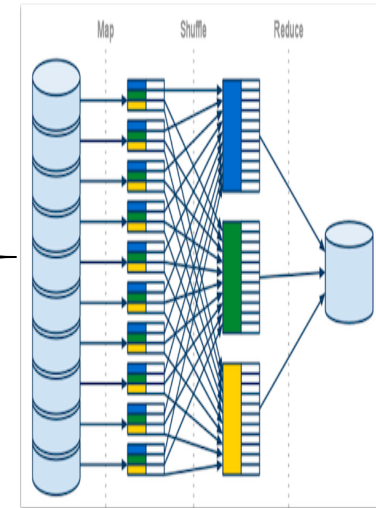
base calls from the sequencer

FASTQ files with base calls

SAM with standard alignment

VCF digests variants

GVF maps to ontologies



De-identified
Data
Warehouse

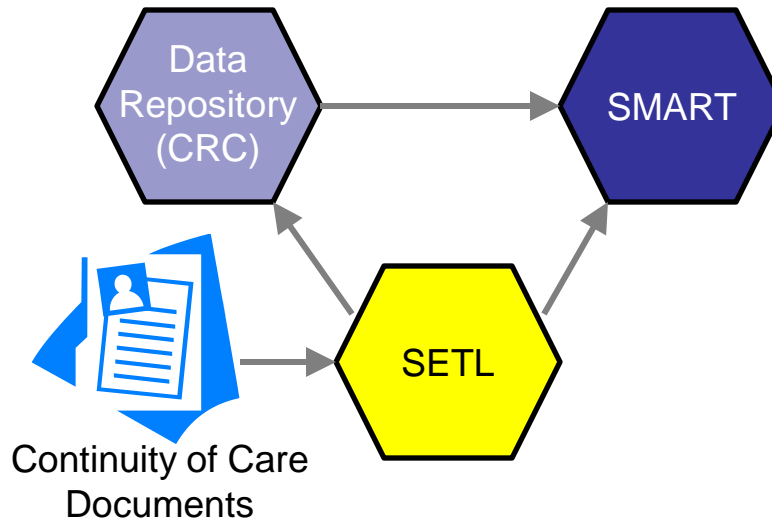
Map-Reduce
Queries

Sequence patterns

Supporting community add-on plug-ins, web services, and ETL processes

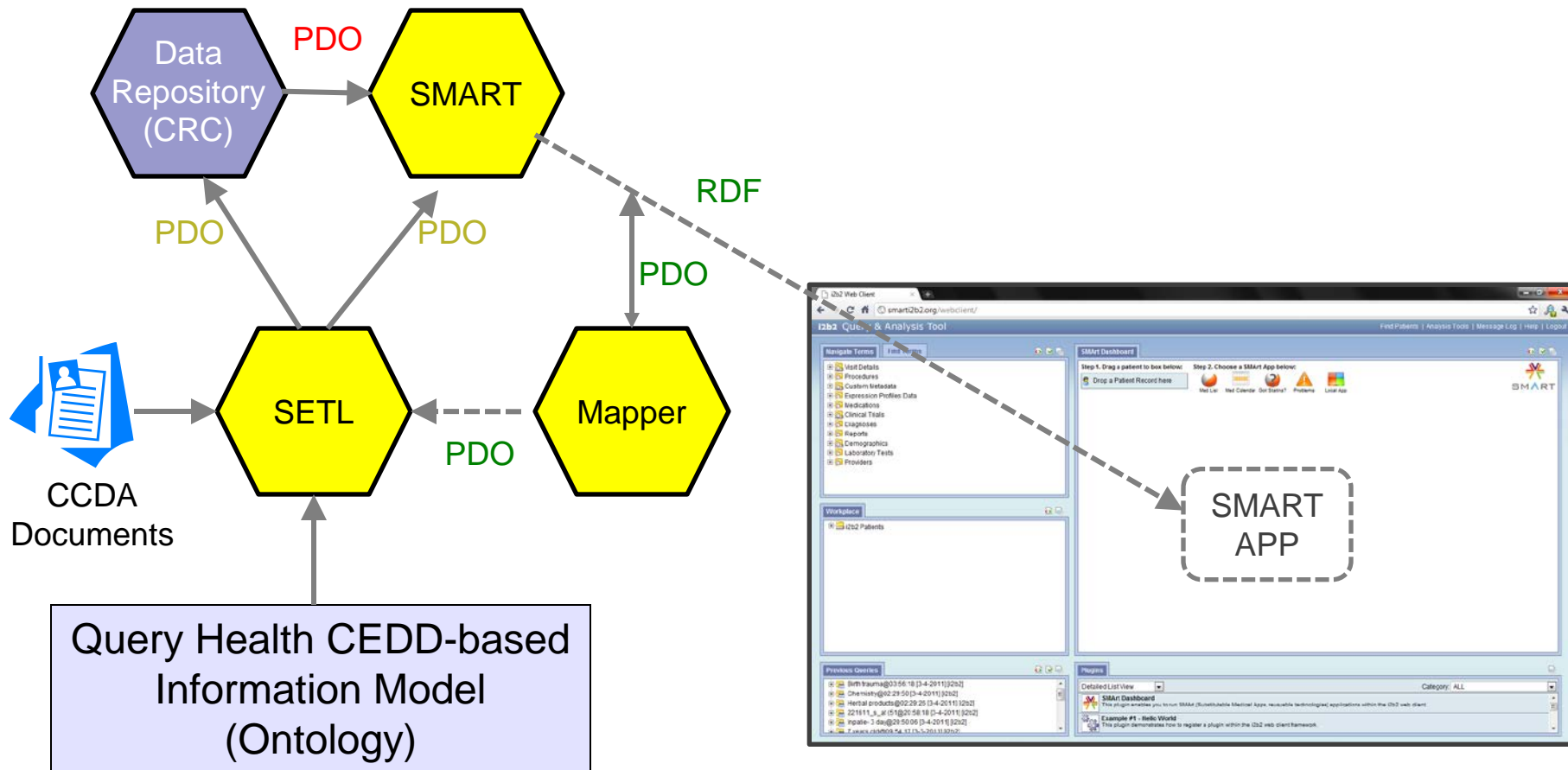
- Streamlined management of download process for supporting plug-ins (will discuss tomorrow)
- Web service architecture to feed data to i2b2
- ETL Bulk loading and Library (will continue tomorrow)

Services ETL Cell from SMART



- EHR systems will generate C-CDA compliant Continuity of Care Documents (CCDs) as part of Meaningful Use
- The Services ETL cell (SETL) will support their use to:
 - Retrieve the latest information on a patient
 - ETL CCDs into i2b2
 - View CCDs in SMART apps

Data flow with Services ETL



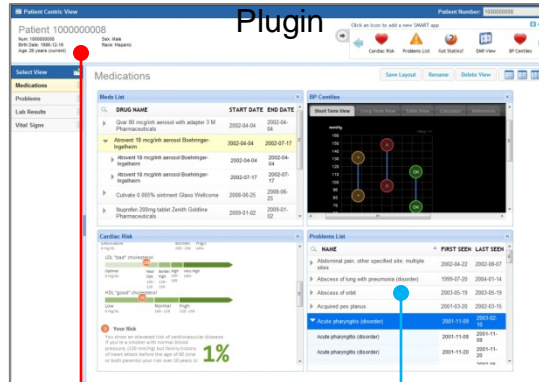
Red = Local Codes
Green = Standard Terminologies

Project Status

- Currently imports demographics from C-CDA documents and the SMART cell can consume them.
 - Running at Partners.
- Design is underway for a full version that will import all document sections required by Meaningful Use.
 - It will use Open Health Tools and the C-CDA ontology developed as part of Query Health.
- Major CCD sections:
 - Problems – SNOMED
 - Demographics – HL7 Codes
 - Meds – RxNorm
 - Labs – LOINC
 - Procedures – SNOMED
 - Allergies – RxNorm
 - Vitals – LOINC
 - Immunizations - CVX codes
 - Smoking, cognitive, and functional status – SNOMED

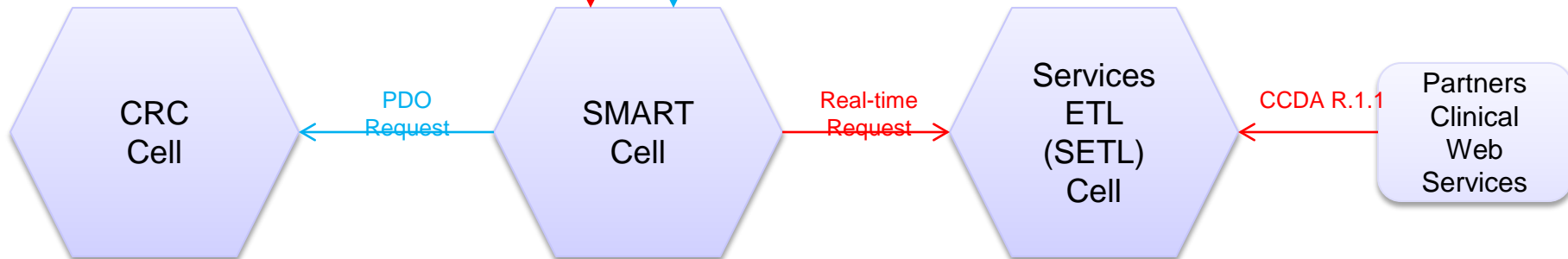
Services ETL Cell

I2b2 Web Client with SMART
Plugin



Demographics
SMART API

Medications
SMART API



Existing Workflow: A SMART app makes a Medications API call to the SMART cell. The SMART cell retrieves Medications data from the i2b2 data warehouse.

New Workflow: A SMART app makes a Demographics API call to the SMART cell. The SMART cell sends the request to the new SETL cell to receive real-time contact data using a CCDA from Partners clinical web services

Services ETL: Input PDO *Request*

```
<ns3:request xsi:type="ns3:GetPDOFromInputList_requestType"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <input_list>
    <patient_list>
      <patient_id>XXXXXXXXXX</patient_id>
      <patient_id>MGH:0000004</patient_id>
    </patient_list>
  </input_list>
  <filter_list>
    <panel name="DEM">
      <panel_number>0</panel_number>
      <panel_accuracy_scale>0</panel_accuracy_scale>
      <invert>0</invert>
      <item>
        <hlevel>1</hlevel>
        <item_key>\\i2b2_DEMO\i2b2\Demographics\</item_key>
        <dim_tablename>concept_dimension</dim_tablename>
        <dim_dimcode>\\i2b2_DEMO\i2b2\Demographics\</dim_dimcode>
        <item_is_synonym>N</item_is_synonym>
      </item>
    </panel>
  </filter_list>
  <output_option>
    <patient_set select="using_input_list" onlykeys="false"/>
    <pid_set select="using_input_list" onlykeys="true"/>
    <observation_set blob="true" onlykeys="false" select="using_input_list"/>
  </output_option>
</ns3:request>
```

Services ETL: Output PDO Response

```
<ns2:patient_set>
  <patient>
    <patient_id source="hive">XXXXXXXXXX</patient_id>
    <param column="vital_status_cd" name="vital_status_cd">U</param>
    <param column="birth_date" name="birth_date">19490101</param>
    <param column="sex_cd" name="sex_cd">M</param>
    <param column="language_cd" name="language_cd">SPANISH</param>
    <param column="religion_cd" name="religion_cd">PROTESTANT</param>
    <param column="race_cd" name="race_cd">OTHER</param>
    <param column="ethnicity_cd" name="ethnicity_cd">AFRICAN</param>
    <param column="marital_status_cd" name="marital_status_cd">UNKNOWN</param>
    <param column="legal_first_name" name="legal_first_name">SANTA</param>
    <param column="legal_middle_initial" name="legal_middle_initial">J</param>
    <param column="legal_last_name" name="legal_last_name">CLAUS</param>
    <param column="legal_suffix" name="legal_suffix">JR</param>
    <param column="permanent_line1" name="permanent_line1">1010 TENTH
      STREET</param>
    <param column="permanent_line2" name="permanent_line2">APT 110</param>
    <param column="permanent_city" name="permanent_city">BOSTON</param>
    <param column="permanent_city" name="permanent_city">MA</param>
    <param column="permanent_city" name="permanent_city">02114</param>
    <param column="permanent_city" name="permanent_city">US</param>
    <param column="local_line1" name="local_line1">55 FRUIT ST</param>
    <param column="local_line2" name="local_line2">APT 2</param>
    <param column="local_city" name="local_city">BOSTON</param>
    <param column="local_city" name="local_city">MA</param>
    <param column="local_city" name="local_city">02114</param>
    <param column="local_city" name="local_city">US</param>
    <param column="primary_phone" name="primary_phone">9781231231217</param>
    <param column="work_phone" name="work_phone">78144455553333</param>
    <param column="mobile_phone" name="mobile_phone">6039275569</param>
    <param column="other_phone" name="other_phone">(987)111-1111</param>
  </patient>
</ns2:patient_set>
```

SMART-i2b2 patient-centric views

The screenshot displays the SMART-i2b2 Workbench interface, which is a patient-centric data visualization tool. The interface is divided into several panes:

- Left Pane (Navigate):** A tree view showing the hierarchy of data sources, including Blood Gases, Blood Gases/Oximetry, CSF Chemistries, and Cardiac Tests. The Cardiac Tests section is expanded, showing various tests like BNP, CK Isos, CK-BB, CK-MB, CK-MB Index, CK-MB QUANT, CK-MB%, CK-MM, CK-MM%, CPK, CRP, High Sens. (Cardio), Interpretation (CKMB), LDH, LDH1, and LDH2.
- Top Pane (Query Tool):** A section for defining queries. It includes a "Query Name" field (CPK (Group:CPK)@02:23:26), a "Dates" section with "Occurs" and "Excludes" tabs, and a "Patient Centric View" section. The "Patient Centric View" section shows a patient's demographic information: Santa J Claus, MRN: 0000004 (MGI), Birth Date: 1949-01-01, Age: 64 years (current), Gender: Male, and Permanent Address: 1010 Tenth Street, Apt 110, Boston, MA 02114.
- Right Pane (Workpla):** A section for managing the workspace, including a "Patient Number" field (1000000008) and a "Medications" section. The "Medications" section shows a list of medications with columns for "DRUG NAME", "START DATE", and "END DATE".
- Bottom Pane (Previous Queries):** A section for managing previous queries, including a "Search By Name" field and a "Find" button.

A callout box highlights the "Patient Centric View" section, stating: "Demographics data is retrieved in real-time from the SETL cell".

The "Medications" section displays a table of medications:

DRUG NAME	START DATE	END DATE
Quar 80 mcg/inh aerosol with M Pharmaceuticals	2002-04-04	2002-07-17
200 ACTUAT (pratropium Bromide 0.010 MG/ACTUAT Metered Dose Inhaler [Atrovent])	2002-04-04	2002-07-17
Cutivate 0.005% ointment Glaxo Wellcome	2008-06-25	2008-06-25
Ibuprofen 200mg tablet Zenith Goldline Pharmaceuticals	2009-01-02	2009-01-02
Cyclobenzaprine Hydrochloride 10mg tablet Geneva Pharmaceuticals	2009-01-22	2009-01-22
nabumetone 750 MG Oral Tablet [Relafen]	2009-01-28	2009-01-28
Acetaminophen-Codaine Phosphate		

The "Previous Queries" section shows a list of queries, including:

- CPK (Group:CPK)@02:23:26 [03-19-2013] [demo]
- De-Identified X@11:31:59 [03-14-2013] [demo]
- De-Identified X@11:31:37 [03-14-2013] [demo]
- Chemistry@11:28:53 [03-14-2013] [demo]
- Chemistry@11:03:15 [03-14-2013] [demo]
- Chemistry@10:55:14 [03-14-2013] [demo]
- CPK (Group:CPK)@02:49:19 [02-26-2013] [demo]
- CPK (Group:CPK)@10:19:23 [02-26-2013] [demo]
- Amoxicillin@00:21:02 [02-25-2013] [demo]
- Trimox 500mg ca@00:16:08 [02-25-2013] [demo]
- Amoxicillin@00:36:24 [02-20-2013] [demo]
- Amoxicillin@00:32:59 [02-20-2013] [demo]
- Trimox 500mg ca@00:11:08 [02-20-2013] [demo]
- Acute myocardia@10:19:02 [02-20-2013] [demo]
- Casts (Group:CA)@11:17:42 [02-13-2013] [demo]
- CPK (Group:CPK)@11:08:05 [02-13-2013] [demo]
- Amoxicillin@11:04:11 [02-13-2013] [demo]
- Trimox 500mg ca@10:40:36 [02-13-2013] [demo]
- Trimox 500mg ca@10:27:51 [02-13-2013] [demo]

The "Timeline View" section shows a list of patients, including:

- Person_#10000
- CPK_(Group:CPK)
- Person_#10000
- CPK_(Group:CPK)
- Person_#1000000025_Female_76yrold_Hispanic
- CPK_(Group:CPK)
- Person_#1000000027_Male_37yrold_Unknown
- CPK_(Group:CPK)
- Person_#1000000055_Female_19yrold_Hispanic
- CPK_(Group:CPK)

The "Patient Set" section shows a list of patients, including:

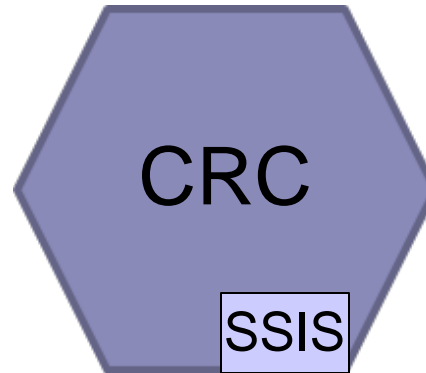
- Person_#10000
- CPK_(Group:CPK)
- Person_#1000000025_Female_76yrold_Hispanic
- CPK_(Group:CPK)
- Person_#1000000027_Male_37yrold_Unknown
- CPK_(Group:CPK)
- Person_#1000000055_Female_19yrold_Hispanic
- CPK_(Group:CPK)

The "Patient Set" section also includes a "Patient Set: 43 Patients" label and a "start: 11 increment: 10" control.

Bulk Loading Observations

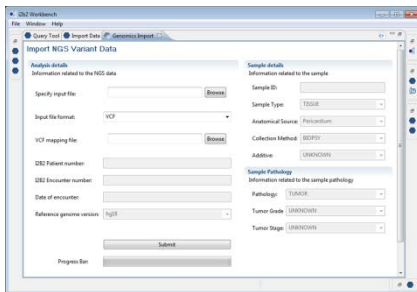
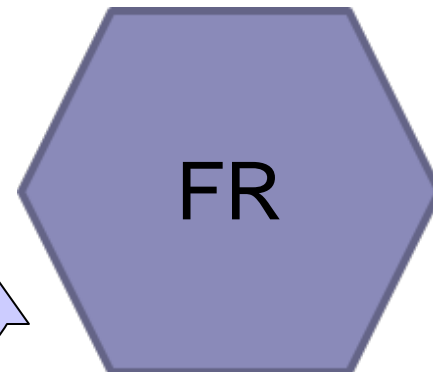
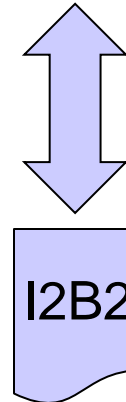
2. Tell the CRC
the file is ready
to load

2



3. SSIS package
loads the i2b2 file to
observation_fact table

3



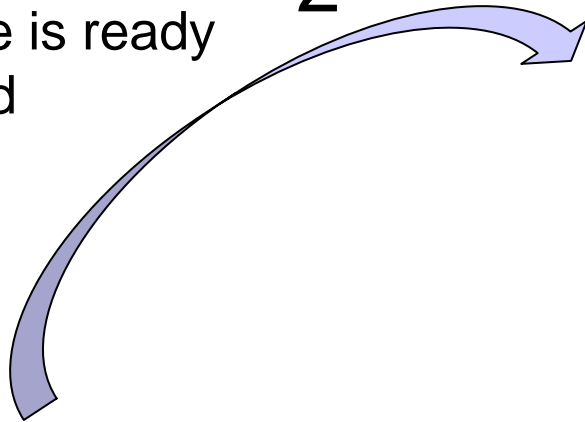
1

1. Send the i2b2 file to the FR

Integration of CRC and FR for file processing

2. Tell the CRC
the file is ready
to load

2



CRC

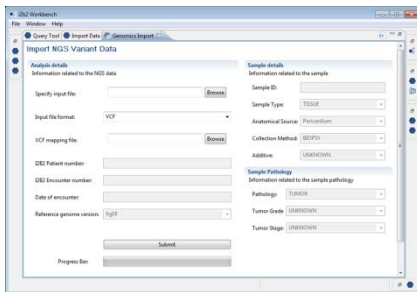
Native App

FR

3

3. Trigger Native
Bulk Loaders to
Import files

I2B2



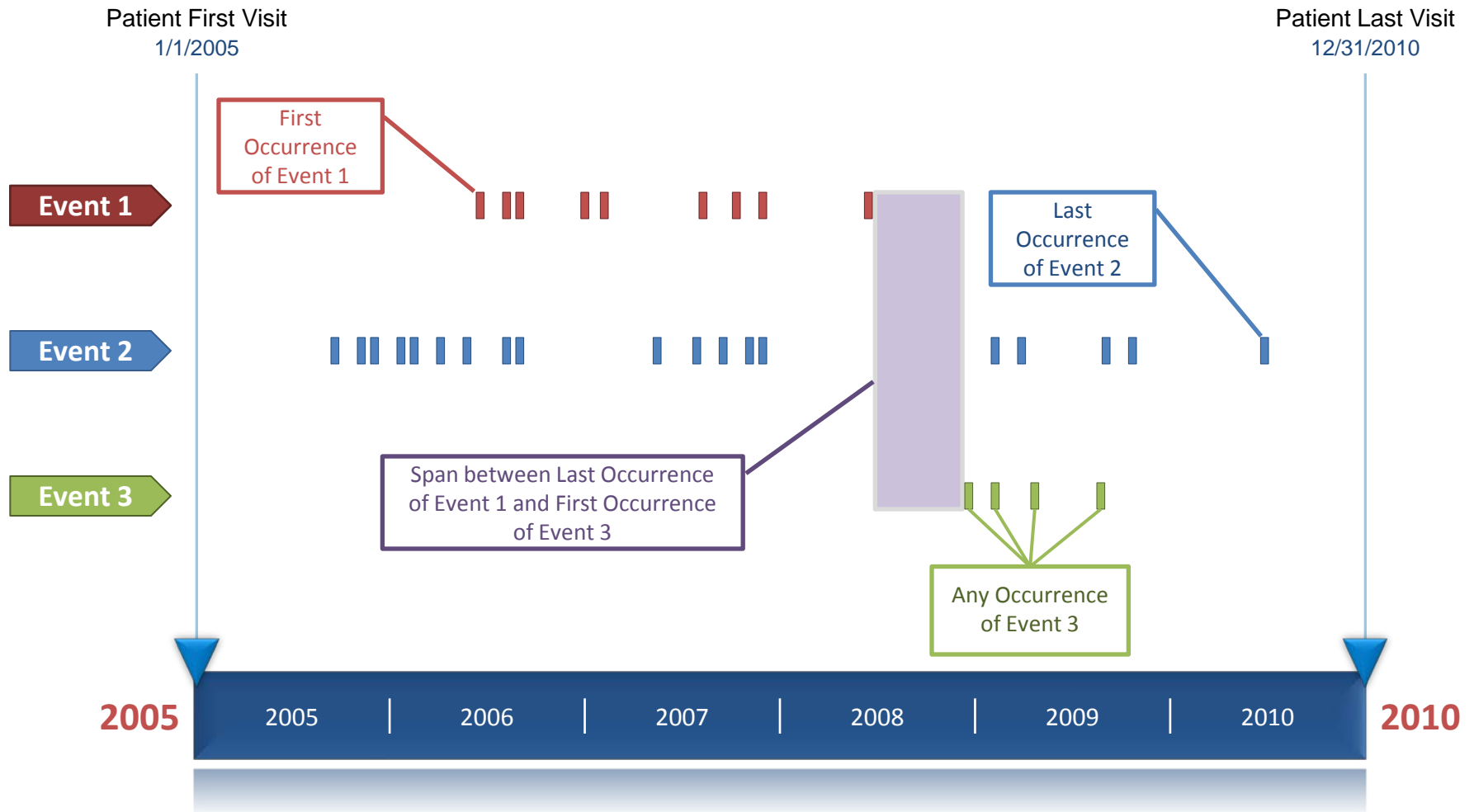
1

1. Send Bulk i2b2 message (as attachment?)

Continued Development

- Simplification of Temporal Query Interface
- Streamline i2b2 Administration
- Support of PostgreSQL

Temporal Query Terminology



Simplification to the Temporal Query Interface

- Background, non-temporal, part of query tool
 - Changed panel orientation to accommodate longer names, modifiers, and value settings
 - Consolidated controls for occurrence and exclusion
 - Panel timing : All occurs in same patient or in same visit
- Interface for temporal queries
 - Everything in an event occurs in one observation

Defining Underlying Patient or Visit Set

The screenshot displays the i2b2 Workbench interface for a 'Demo SQL Server'. The main window is titled 'i2b2 Workbench for Demo SQL Server' and shows the user 'i2b2 User' with a green status indicator. The interface is divided into several panes:

- Left Pane:** Contains a tree view with folders for 'Clinical Trials', 'Custom Metadata', 'Ontology', and 'Sequence Ontology'. Below this is a 'Search By Name' section with a dropdown set to 'Containing' and a 'Find' button. At the bottom, a list of search results is visible, including 'Male->= 65 y@11:' and 'SNV/SNP-Diabetes@'.
- Top Pane:** Features tabs for 'Align-in-time View', 'Temporal Query Tool', and 'Query Tool'. The 'Query Tool' tab is active.
- Query Name:** A dropdown menu is set to 'Underlying Patient Set'.
- Groups Bounded by:** A tree view showing 'Observation', 'Encounter', and 'Patient'. 'Patient' is selected.
- Date Constraints:** Two radio buttons are present: 'Group-Specific' (selected) and 'Query-Wide'.
- Groups:** A list of groups is shown:
 - Group 1:** Male. Patient. No Date Constraints. >0.
 - Group 2:** >= 65 years old. Patient. No Date Constraints. >0.
- Buttons:** An 'Add Group' button is located at the bottom right of the groups list. A 'Next' button is at the bottom center.

Defining Temporal Relationships

The screenshot displays the i2b2 Workbench for Demo SQL Server interface. The top menu bar includes File, Search, Window, Help, Run, and CodePro. The user is logged in as i2b2 User with a green status indicator.

The interface is divided into several sections:

- Left Sidebar:** Contains a tree view with folders for Clinical Trials, Custom Metadata, Ontology, and Sequence Ontology. Below this is a 'Search By Name' section with a 'Containing' dropdown and a 'Find' button. A list of search results is shown at the bottom, including 'Male->= 65 y@11:' and various SNV/SNP-Diabetes related entries.
- Temporal Query Tool Panel:** This panel is active and contains three main sections:
 - Events in Query:** Lists two events. Event 1 is 'Asthma' with 'No Date Constraints' and is anchored by observations. Event 2 is 'Albuterol' with 'No Date Constraints' and is also anchored by observations. There are '+ Add Group' and '+ Add Event' buttons.
 - Underlying Patient Set:** Lists two groups. Group 1 is 'Male' with 'No Date Constraints'. Group 2 is '>= 65 years old' with 'No Date Constraints'. There are '+ Add Group' and '+ Add Event' buttons.
 - Define Temporal Relationships Among Events:** This section allows defining relationships between events. It includes dropdowns for 'Start of', 'the First Ever', and event selection (Event 1, Event 2). A 'Occurs Before' dropdown is also present. Below these are checkboxes for 'By' and 'And' with associated numerical values and units (e.g., 1 day(s)). A '+ Add Temporal Relationship' button is at the bottom, with a note: 'Add Temporal Relationships among Events defined in the panel to the left.'
- Bottom Panel:** Features a 'Submit Query' button.

Viewing Temporal Relationships in Time Align

i2b2 Workbench

i2b2 Workbench for i2b2 Demo 1.7 on Oracle

i2b2 User Status: ● i2b2

File Search Window Help Run

Navigate Terms

- Patient Instructions
- Route
- Rx Sig
- Antiasthmatic combinations
- Antihistamines
- Antitussives
- Bronchodilators
 - Patient Instructions
 - Route
 - Rx Sig
- Adrenergic bronchodilators
 - Patient Instructions
 - Route
 - Rx Sig
- Albuterol
- Bitolterol
- Epinephrine
- Formoterol

Query Tool (Experimental)

Query Name: Specify Temporal Query

Events in Query

- Event 1 No Date Constraints
- Event 2 No Date Constraints

+ Add Event

Define Temporal Relationships Among Events

Start of the First Ever Event 1

Occurs Before

Start of the First Ever Event 2

By 6 month(s)

And 1 day(s)

+ Add Temporal Relationship

Event Inclusion

☒ Only query for Events used in Temporal Relationships

Submit Query Patient(s) Returned: 6.

Align-in-time View

Create model for Timeline Render a Timeline

Record View Comparison View Group View

All Records Records 6/6 Zoom to: Years Annotate!

1000000003 Albuterol Asthma

1000000020 Albuterol Asthma

1000000021 Albuterol Asthma

1000000065 Albuterol Asthma

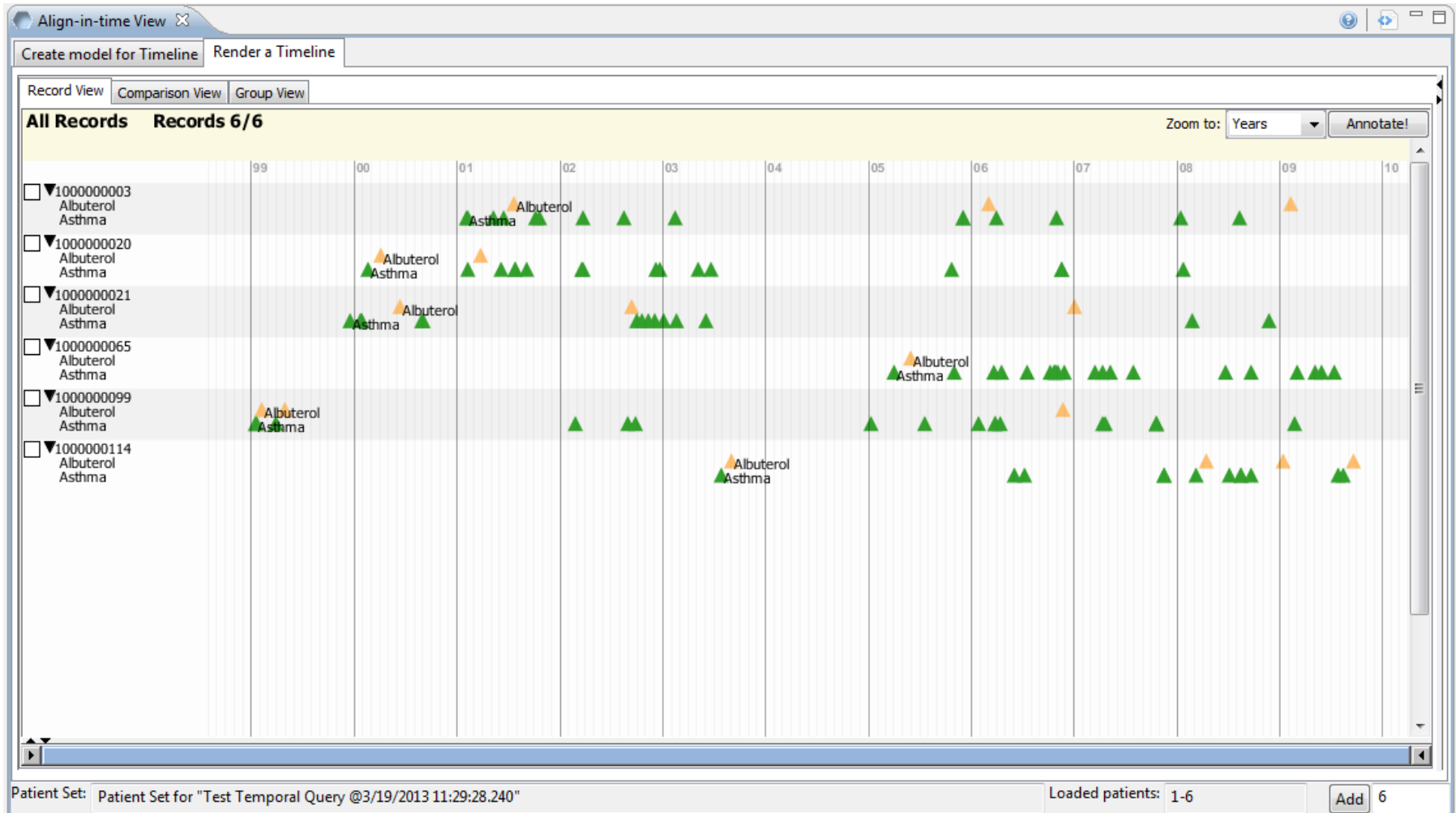
1000000099 Albuterol Asthma

1000000114 Albuterol Asthma

Patient Set: Patient Set for "Test Temporal Query @3/19/2013 11:29:28.240"

Loaded patients: 1-6 Add 6

Viewing Temporal Relationships in Time Align





PARTNERSTM
HEALTHCARE SYSTEM

UPDATES

- ✓ JBoss 7.1
- ✓ All POJO
- ✓ Axis 1.6.1
- ✓ Oracle 11g



JBoss 7

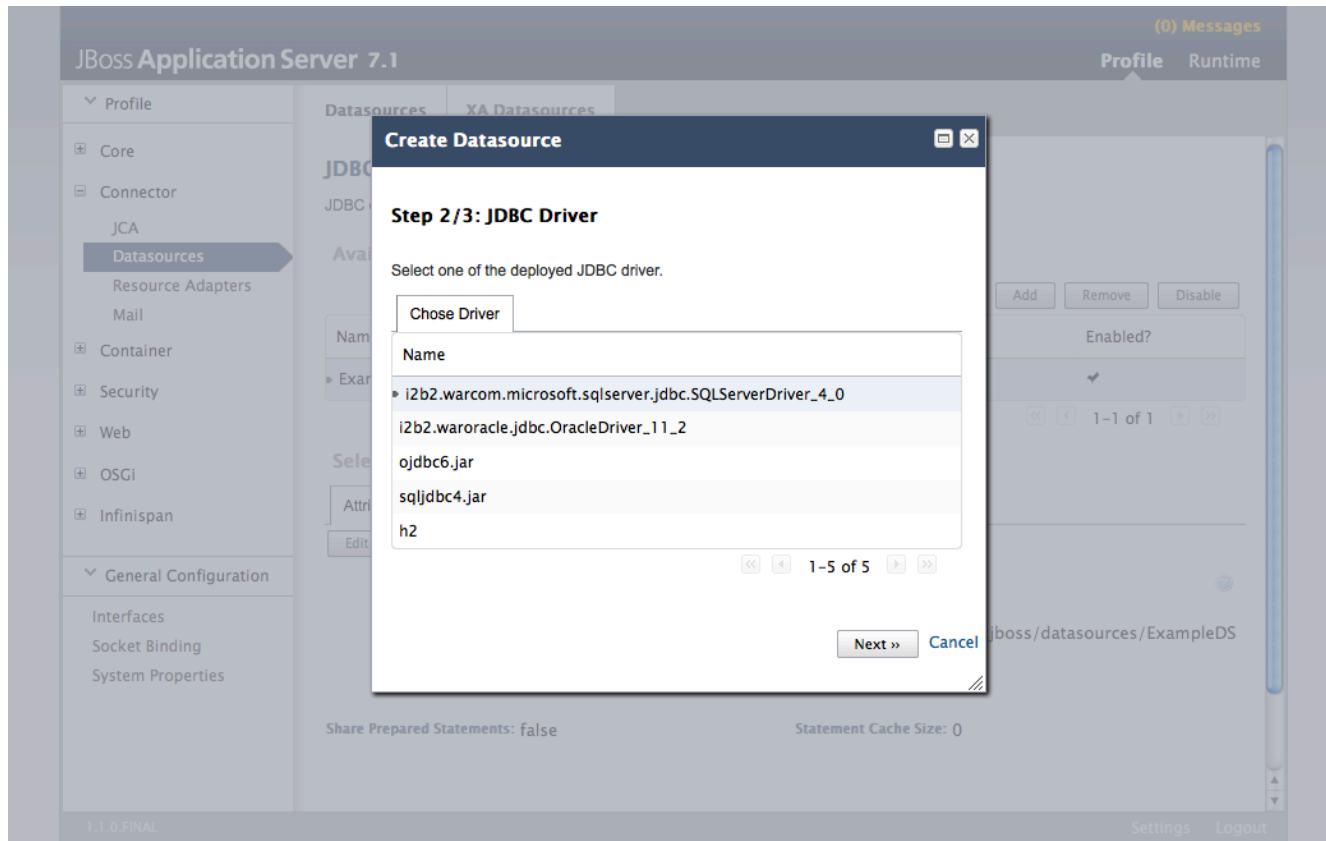
- ✓ Improved Performance
 - ✓ Better Security
 - ✓ J2EE 6
- ✓ Administration Improvements
 - ✓ Integrate into Eclipse



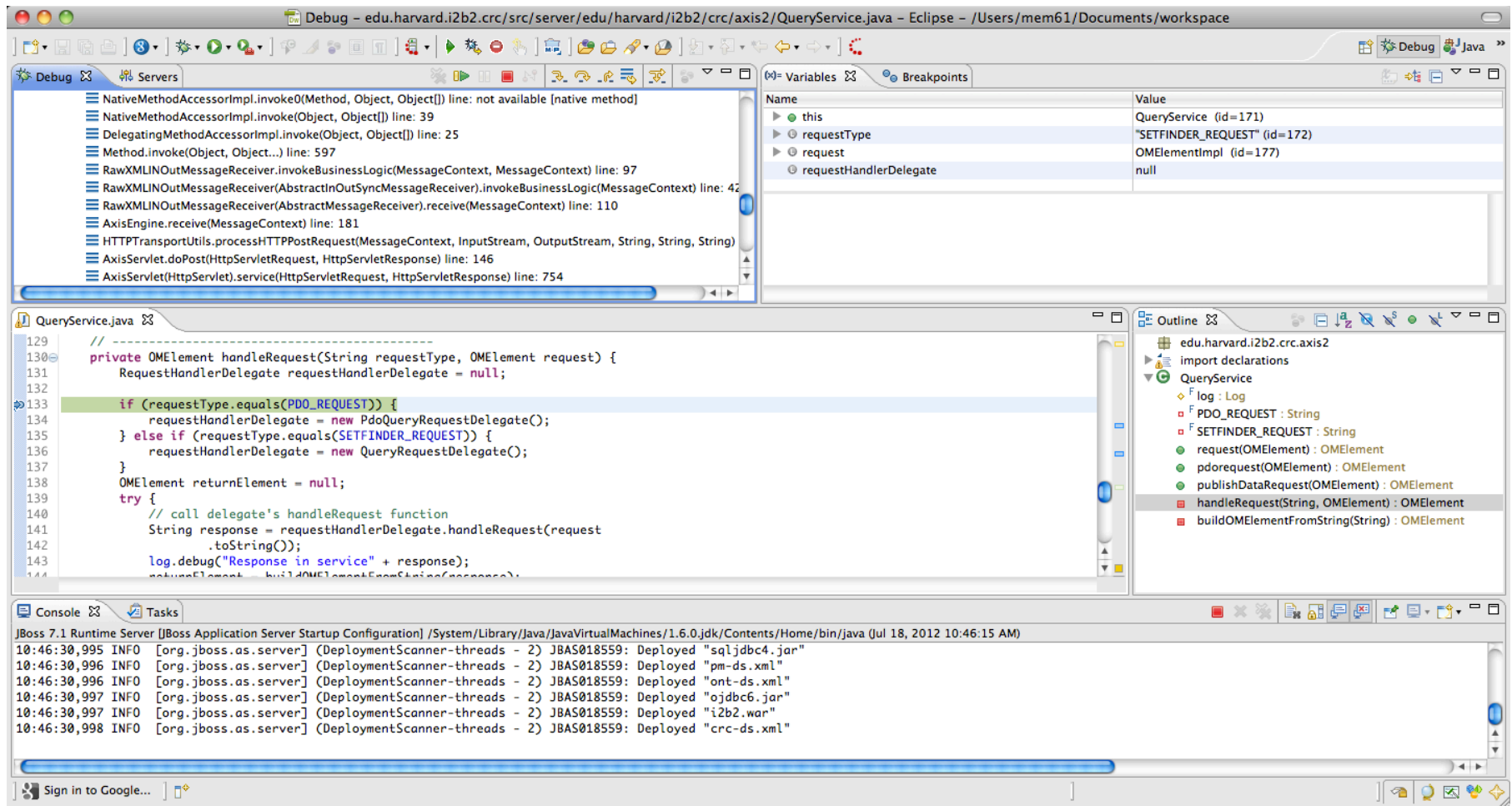
PARTNERSTM
H E A L T H C A R E S Y S T E M



DATASOURCE CAN BE CONFIGURED VIA WEB



DEBUGGING IN ECLIPSE



Debug - edu.harvard.i2b2.crc/src/server/edu/harvard/i2b2/crc/axis2/QueryService.java - Eclipse - /Users/mem61/Documents/workspace

Debug Console:

```
NativeMethodAccessorImpl.invoke0(Method, Object, Object[]) line: not available [native method]
NativeMethodAccessorImpl.invoke(Object, Object[]) line: 39
DelegatingMethodAccessorImpl.invoke(Object, Object[]) line: 25
Method.invoke(Object, Object...) line: 597
RawXMLINOutMessageReceiver.invokeBusinessLogic(MessageContext, MessageContext) line: 97
RawXMLINOutMessageReceiver(AbstractInOutSyncMessageReceiver).invokeBusinessLogic(MessageContext) line: 42
RawXMLINOutMessageReceiver(AbstractMessageReceiver).receive(MessageContext) line: 110
AxisEngine.receive(MessageContext) line: 181
HTTPTransportUtils.processHTTPPostRequest(MessageContext, InputStream, OutputStream, String, String, String)
AxisServlet.doPost(HttpServletRequest, HttpServletResponse) line: 146
AxisServlet(HttpServlet).service(HttpServletRequest, HttpServletResponse) line: 754
```

Variables:

Name	Value
this	QueryService (id=171)
requestType	"SETFINDER_REQUEST" (id=172)
request	OMElementImpl (id=177)
requestHandlerDelegate	null

QueryService.java

```
129 // -----
130 private OMElement handleRequest(String requestType, OMElement request) {
131     RequestHandlerDelegate requestHandlerDelegate = null;
132
133     if (requestType.equals(PDO_REQUEST)) {
134         requestHandlerDelegate = new PdoQueryRequestDelegate();
135     } else if (requestType.equals(SETFINDER_REQUEST)) {
136         requestHandlerDelegate = new QueryRequestDelegate();
137     }
138     OMElement returnElement = null;
139     try {
140         // call delegate's handleRequest function
141         String response = requestHandlerDelegate.handleRequest(request)
142             .toString();
143         log.debug("Response in service" + response);
144         returnElement = buildOMElementFromResponse(response);
145     } catch (Exception e) {
146         log.error("Error in service", e);
147     }
148     return returnElement;
149 }
```

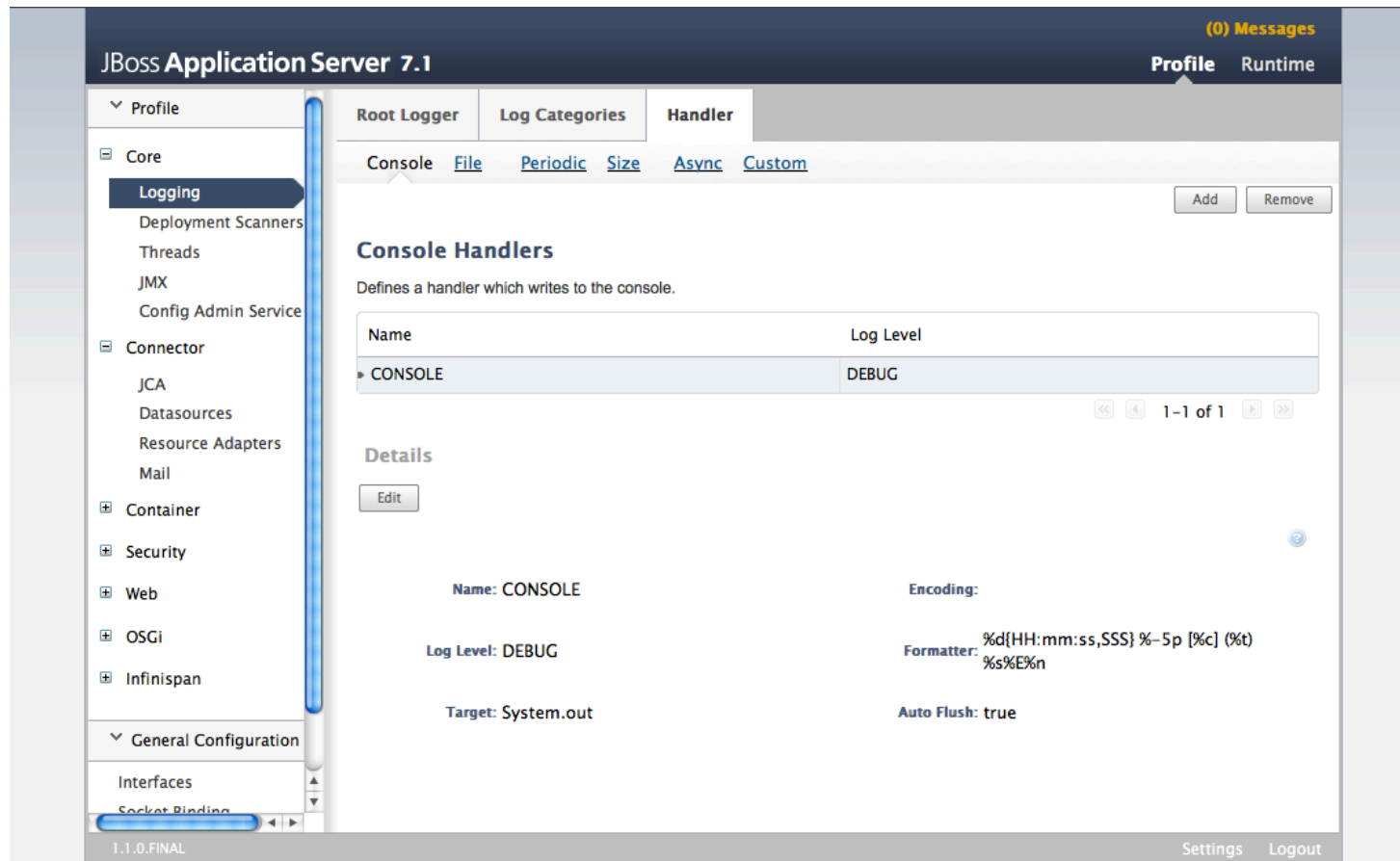
Outline:

- edu.harvard.i2b2.crc.axis2
 - import declarations
 - QueryService
 - log : Log
 - PDO_REQUEST : String
 - SETFINDER_REQUEST : String
 - request(OMElement) : OMElement
 - pdoRequest(OMElement) : OMElement
 - publishDataRequest(OMElement) : OMElement
 - handleRequest(String, OMElement) : OMElement
 - buildOMElementFromString(String) : OMElement

Console:

```
JBoss 7.1 Runtime Server [JBoss Application Server Startup Configuration] /System/Library/Java/JavaVirtualMachines/1.6.0.jdk/Contents/Home/bin/java (Jul 18, 2012 10:46:15 AM)
10:46:30,995 INFO [org.jboss.as.server] (DeploymentScanner-threads - 2) JBAS018559: Deployed "sqljdbc4.jar"
10:46:30,996 INFO [org.jboss.as.server] (DeploymentScanner-threads - 2) JBAS018559: Deployed "pm-ds.xml"
10:46:30,996 INFO [org.jboss.as.server] (DeploymentScanner-threads - 2) JBAS018559: Deployed "ont-ds.xml"
10:46:30,997 INFO [org.jboss.as.server] (DeploymentScanner-threads - 2) JBAS018559: Deployed "ojdbc6.jar"
10:46:30,997 INFO [org.jboss.as.server] (DeploymentScanner-threads - 2) JBAS018559: Deployed "i2b2.war"
10:46:30,998 INFO [org.jboss.as.server] (DeploymentScanner-threads - 2) JBAS018559: Deployed "crc-ds.xml"
```

LOGGING



The screenshot displays the JBoss Application Server 7.1 management console. The left sidebar shows a tree view with 'Logging' selected under the 'Core' section. The main panel is titled 'JBoss Application Server 7.1' and includes tabs for 'Profile' and 'Runtime'. Below these are tabs for 'Root Logger', 'Log Categories', and 'Handler'. The 'Handler' tab is active, showing a list of 'Console Handlers'. A table lists one handler named 'CONSOLE' with a 'Log Level' of 'DEBUG'. Below the table, the 'Details' section for the 'CONSOLE' handler is shown, including fields for 'Name', 'Log Level', 'Target', 'Encoding', 'Formatter', and 'Auto Flush'.

JBoss Application Server 7.1

(0) Messages

Profile Runtime

▼ Profile

- Core
 - Logging**
 - Deployment Scanners
 - Threads
 - JMX
 - Config Admin Service
- Connector
 - JCA
 - Datasources
 - Resource Adapters
 - Mail
- Container
- Security
- Web
- OSGi
- Infinispan

▼ General Configuration

- Interfaces
- Socket Binding

Root Logger Log Categories Handler

Console File Periodic Size Async Custom

Add Remove

Console Handlers

Defines a handler which writes to the console.

Name	Log Level
CONSOLE	DEBUG

1-1 of 1

Details

Edit

Name: CONSOLE

Log Level: DEBUG

Target: System.out

Encoding:

Formatter: %d[HH:mm:ss,SSS] %-5p [%c] (%t)
%s%E%n

Auto Flush: true

1.1.0.FINAL

Settings Logout

Summary

- Supporting cohort discovery and recruitment “out of the box” for clinical and observational trials.
- Supporting future query systems either outside of the Data Repository or within NoSQL systems
- Supporting add-on plug-ins, web services, and ETL processes
- Simplification of Temporal Query Interface
- Streamline i2b2 Administration
- Support of PostgreSQL

Special thanks to...

■ SMART i2b2 Team

- Nich Wattanasin - Project Manager
- Alyssa Porter - Analyst
- Stella Ubaha – Developer
- Jeff Klann - Informatician

■ i2b2 – SHRINE Team

- Nich Wattanasin
- Michael Mendis
- William Simons
- Douglas MacFadden

■ SMART Core Team

- Isaac Kohane – Co-PI
- Kenneth Mandl – Co-PI
- Joshua Mandel
- Rachel Ramoni
- David Kreda

■ I2b2 Core Team

- Isaac Kohane
- Susanne Churchill
- Shawn Murphy
- Michael Mendis
- Lori Phillips
- Wensong Pan
- Janice Donahoe
- Nich Wattanasin
- David Wang
- Christopher Herrick
- Bill Wang
- Vivian Gainer
- Andrew Cagan

Web Resources

- SMART i2b2 Homepage:
www.smarti2b2.org
- SMART Platforms Homepage:
www.smartplatforms.org
- i2b2 Community Site:
community.i2b2.org
- i2b2 Software:
www.i2b2.org/software
- i2b2 Homepage:
www.i2b2.org