



SMART-i2b2 Update

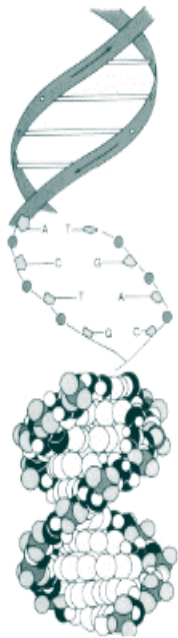
Nich Wattanasin, MS

Jeff Klann, Ph.D.

Alyssa Porter, MS

Stella Ubaha

Shawn Murphy MD, Ph.D.

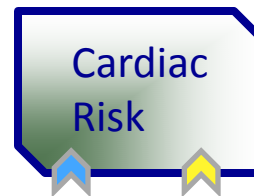
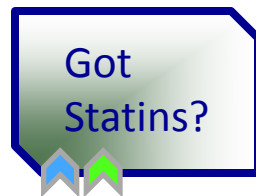


Substitutable Medical Apps, Reusable Technologies

- SMART provides a mechanism for individual medical records to be displayed in an “App”
- SMART defines an API and a data model in RDF to represent clinical data types such as Medications, Diagnoses, Allergies, Lab Results, Fulfillments, Immunizations, Vital Signs, etc.
- **SMART Apps** built against the SMART API can be embedded within any existing or future **SMART Container**
- A SMART Container can be an EMR system used by physicians, a PCHR used by patients, or a **data-analytics platform such as i2b2**

SMART Overview

Apps



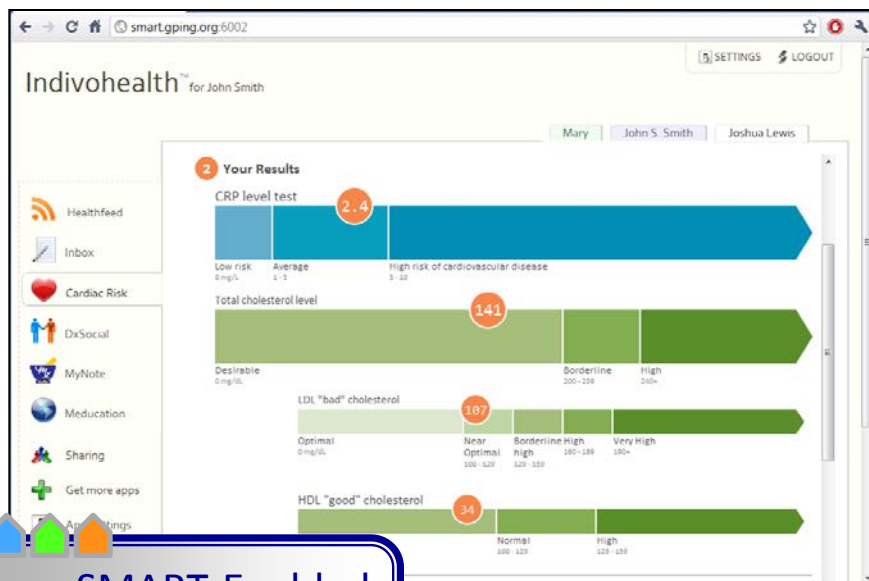
API



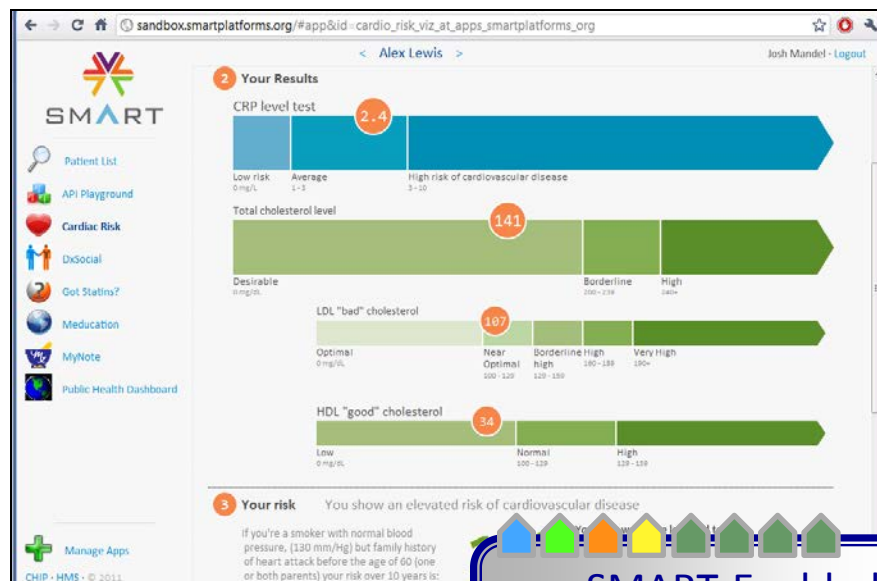
Containers



What is SMART?



SMART-Enabled
PCHR



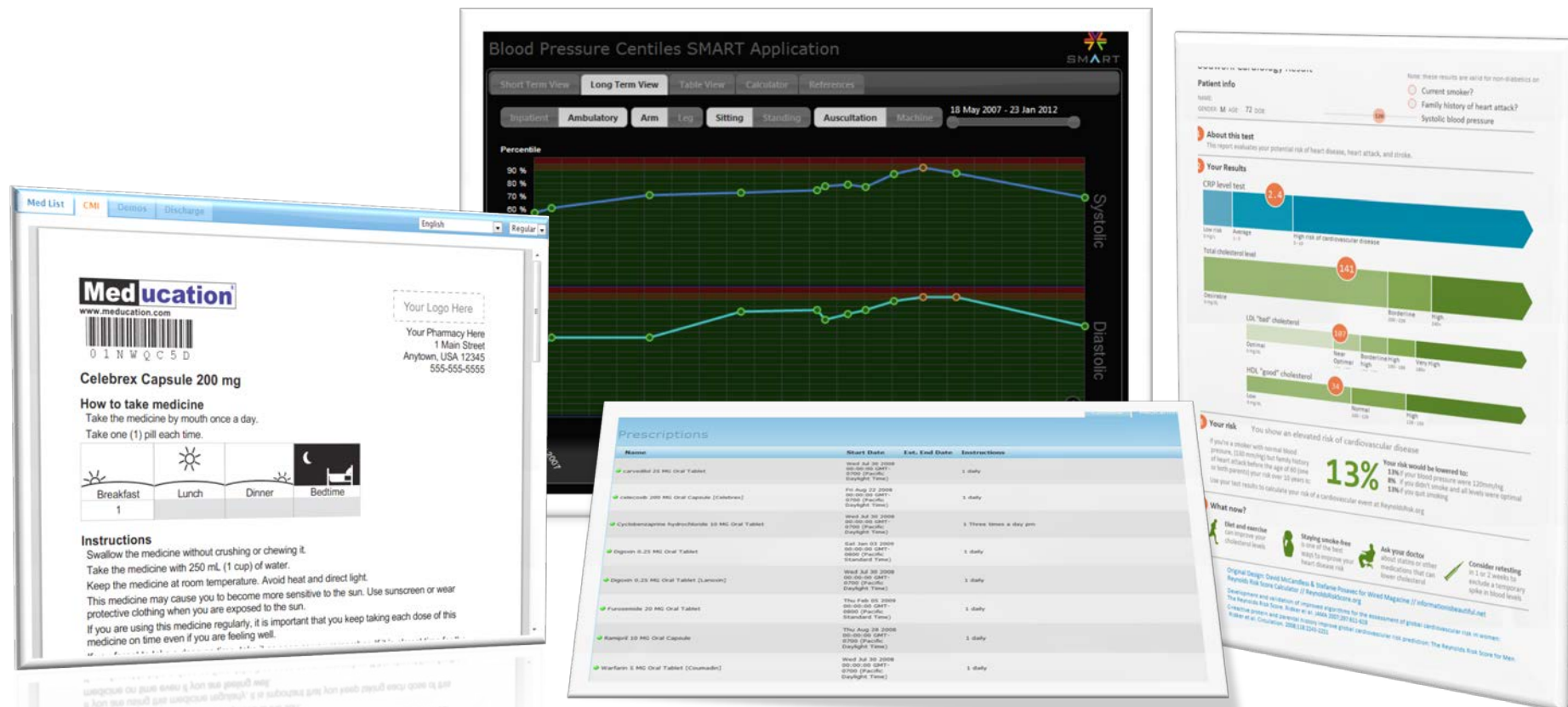
SMART-Enabled
EMR



SMART-Enabled
i2b2

Purpose of SMART + i2b2

- Enable i2b2 to support the SMART API, allowing current and future SMART apps to interact with data stored in i2b2
- Extend functionality in the i2b2 web client, to allow investigators to use these SMART apps for exciting use cases (e.g. clinical trials)



How to 'SMART Enable' i2b2

Three new components:

SMART i2b2 cell

Mapper i2b2 cell

Patient-Centric View

i2b2 Hive

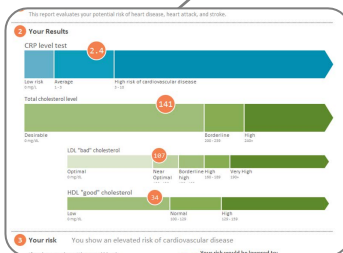
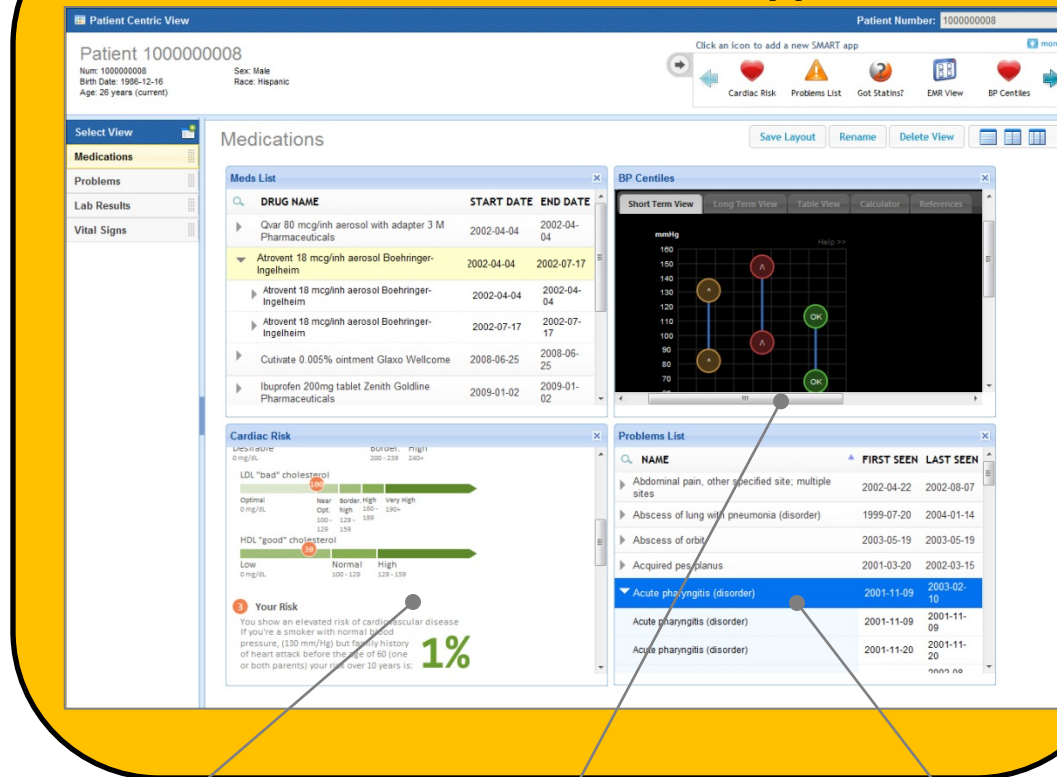
CRC

SMART

Mapper

Ontology

Patient-Centric View App



Your
SMART
App



SMART

SMART i2b2 Cell

- Implements SMART API in i2b2 to produce
- SMART Cell registers Apps – no rogue apps
- Handles authorization – OAuth based



SMART RDF

Allergies
Clinical Notes
Demographics
Fulfillments
Immunizations
Lab Results
Medications
Notes
Problems
Vital Signs

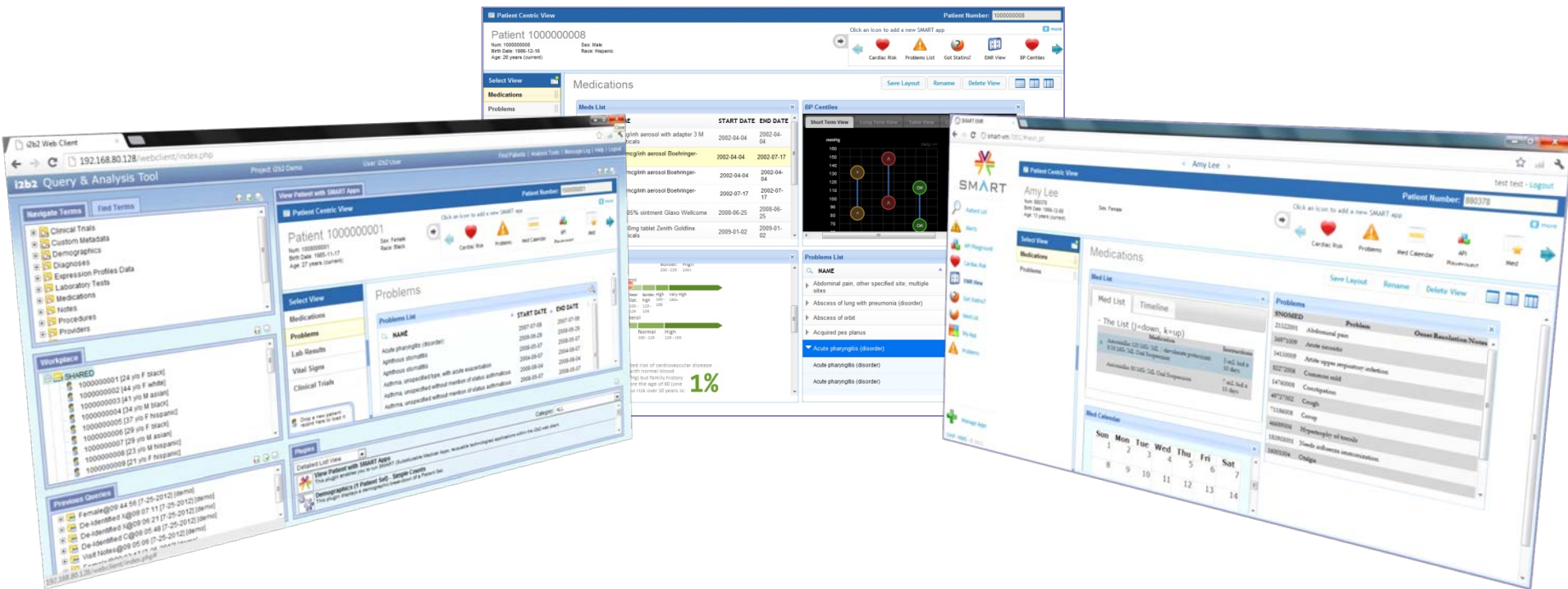
- Contains mapping table of local codes to SMART preferred coding systems
 - Provides assistance
 - Starter table that maps 85% of most used terms¹
 - I2b2 user tool for mapping everything else
- SNOMED**
RxNorm
LOINC

1. Based on Partners HealthCare's Research Patient Data Repository (RPDR) data warehouse data between 1986-2011

Patient-Centric View App

SMART Patient-Centric View App

- Allows user to create data views of specific areas of interest
- User selects installed apps from carousel and arranges into preferred views
- Multiple SMART apps run simultaneously



Patient 1000000008

Num: 1000000008
Birth Date: 1986-12-16
Age: 26 years (current)

Sex: Male
Race: Hispanic

Click an icon to add a new SMART app

+ more



Cardiac Risk



Problems List



Got Statins?



EMR View



BP Centiles



Select View

Medications

Problems

Lab Results

Vital Signs

Medications

Save Layout

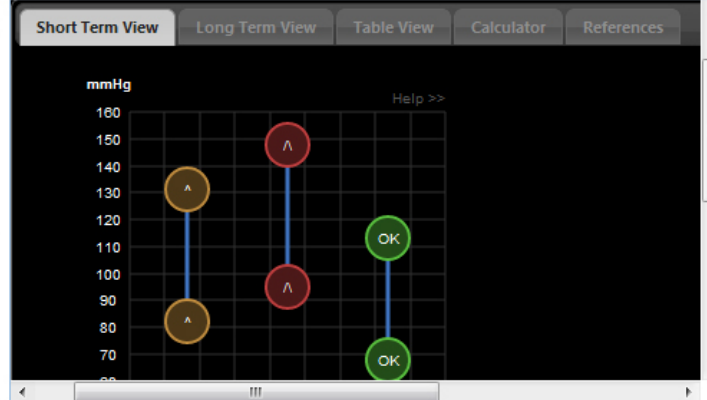
Rename

Delete View

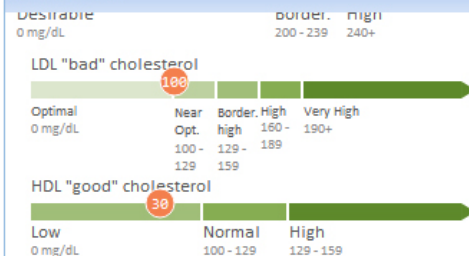
Meds List

DRUG NAME	START DATE	END DATE
Qvar 80 mcg/inh aerosol with adapter 3 M Pharmaceuticals	2002-04-04	2002-04-04
▼ Atrovent 18 mcg/inh aerosol Boehringer-Ingelheim	2002-04-04	2002-07-17
▶ Atrovent 18 mcg/inh aerosol Boehringer-Ingelheim	2002-04-04	2002-04-04
▶ Atrovent 18 mcg/inh aerosol Boehringer-Ingelheim	2002-07-17	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

BP Centiles



Cardiac Risk



3 Your Risk

You show an elevated risk of cardiovascular disease. If you're a smoker with normal blood pressure, (130 mm/Hg) but family history of heart attack before the age of 60 (one or both parents) your risk over 10 years is:

1%

Problems List

NAME	FIRST SEEN	LAST SEEN
▶ Abdominal pain, other specified site; multiple sites	2002-04-22	2002-08-07
▶ Abscess of lung with pneumonia (disorder)	1999-07-20	2004-01-14
▶ Abscess of orbit	2003-05-19	2003-05-19
▶ Acquired pes planus	2001-03-20	2002-03-15
▼ Acute pharyngitis (disorder)	2001-11-09	2003-02-10
Acute pharyngitis (disorder)	2001-11-09	2001-11-09
Acute pharyngitis (disorder)	2001-11-20	2001-11-20

SMART List Apps

List Apps

■ Low Entry Barrier

- List apps do not do computable things on standardized codes
- If mappings not available, list app will display local data

■ Developed SMART Apps

- Allergies List
- Lab Results List
- Immunization List
- **Medications List**
- Notes List
- **Problems List**

Meds List			
Q	DRUG NAME	START DATE	END DATE
▶	Sulfamethoxazole-Trimethoprim 80mg-16 mg/ml solution ESI Lederle Generics	2007-03-29	2007-03-29
▶	Penicillin V Potassium 500 MG Oral Tablet	2007-05-01	2007-05-01
▶	montelukast 5 MG Chewable Tablet [Singulair]	2007-06-28	2007-06-28
▶	60 ACTUAT Fluticasone propionate 0.11 MG/ACTUAT Metered Dose Inhaler [Flovent]	2007-06-28	2007-06-28
▶	Albuterol Sulfate 4mg tablet ESI Lederle Generics	2007-09-20	2007-09-20
▶	Salbutamol 40 MG ESI		

Problems List			
Q	NAME	START DATE	END DATE
	Acute pharyngitis (disorder)	2007-07-09	2007-07-09
	Aphthous stomatitis	2009-06-29	2009-06-29
	Aphthous stomatitis	2008-05-07	2008-05-07
	Asthma, unspecified type, with acute exacerbation	2004-09-07	2004-09-07
	Asthma, unspecified without mention of status asthmaticus	2008-08-04	2008-08-04
	Asthma, unspecified without mention of status asthmaticus	2008-05-07	2008-05-07
	Asthma, unspecified without mention of status asthmaticus	2007-09-12	2007-09-12
	Asthma, unspecified without mention of status asthmaticus	2007-01-05	2007-01-05

Lessons Learned

- Achievement of substitutable apps is possible
- Straightforward SMART model facilitated implementation
- Having to learn RDF for app development was a barrier
- Full HTML5 compatibility a challenge in older browsers
- Want coding standard “escape” to display non-mapped data

Downloads

- VMWare Virtual Machine running CentOS with entire i2b2 stack + new SMART components
- Full source code available
- <http://www.smarti2b2.org>

Special thanks to...

■ SMART i2b2 Team

- Nich Wattanasin – PM, Developer
- Jeff Klann - Informatician
- Alyssa Porter - Analyst
- Stella Ubaha - Developer
- Shawn Murphy – PI

■ SMART Core Team

- Isaac Kohane – Co-PI
- Kenneth Mandl – Co-PI
- Joshua Mandel
- Rachel Ramoni
- David Kreda
- Nikolai Schwertner
- Arjun Sanyal, and others!

■ i2b2 Team

- Michael Mendis
- Janice Donahoe
- Lori Phillips

■ 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