Beyond the EHR:
Substitutable Medical Apps on the HIE

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Healthcare IT **Innovation** Challenges

Why can't innovators widely share their work **?**

Why can't clinical IT systems advance faster **?**

Why can't providers & vendors tap more IT talent **?**

Health IT Standards Today …

Focused on **document** exchange

Not open or free

Not adequately expressive

Not unambiguous

Not easy to learn

Summation: Not *developer-friendly*

Not open …

CCR Example

Licensee may access and download an electronic file of a Document … for temporary storage on one computer … or printing one copy. …

Neither the electronic file nor the single hard copy print may be reproduced in any way.

Not free ...

HL7 Health Level Seven International

HL7 STANDARDS LISTED IN HHS' FINAL RULE			More Information
Item	Member	NonMember	Add
CDA® Release 2 Electronic Copy	$0	$50	ADD
Continuity of Care Document (CCD®) Release 1	$0	$50	ADD
HL7 Messaging Standard Version 2.3.1 in PDF (electronic version)	$0	$775	ADD
HL7 Messaging Standard Version 2.5.1 in PDF (electronic version)	$0	$705	ADD
HL7 Version 2.5.1 Implementation Guide: Electronic Laboratory Reporting to Public Health, Release 1 (US Realm) (electronic version in PDF)	$0	$50	ADD

HL7'S VERSION 3 MESSAGING STANDARD			More Information
Item	Member	NonMember	Add
HL7 Version 3 Normative Edition, 2010 (electronic version)	$0	$705	ADD
HL7 Version 3 Normative Edition, 2009 (electronic version)	$0	$705	ADD
HL7 Version 3 Normative Edition, 2008 (electronic version)	$0	$705	ADD
HL7 Version 3 Normative Edition, 2006 (electronic version)	$0	$705	ADD
HL7 Version 3 Normative Edition, 2005 (electronic version)	$0	$705	ADD

Not adequately expressive ...

Blood pressure expression needs:

Table 2-33 Vital Signs Data Mapping Table – Definitions

Identifier	Name	Definition	Constraints
14.01	Vital Sign Result ID	An identifier for this specific vital sign observation	
14.02	Vital Sign Result	The biologically relevant date/time for the vital sign	
14.03	Vital Sign Result Type	A coded representation of the vital sign observation	C83-[DE-14.03-1] Vital signs SHOULD be coded as specified in HITSP/C80 Section 2.2.3.6.4 Vital Sign Result Type.
14.04	Vital Sign Result	Status for this vital sign observation, e.g., complete,	
14.05	Vital Sign Result	The value of the result, including units of measure if applicable	
14.06	Vital Sign Result Interpretation	An abbreviated interpretation of the vital sign observation, e.g., normal, abnormal, high, etc	
14.07	Vital Sign Result Reference Range	Reference range(s) for the vital sign observation	

- **position of patient**
- **site of measurement**
- **measurement technique**
- **cuff size**

Not unambiguous ...

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14.04	Vital Sign Result Status	Status for this vital sign observation, e.g., complete, preliminary	
14.05	Vital Sign Result Value	The value of the result, including units of measure if applicable	
14.06	Vital Sign Result Interpretation	An abbreviated interpretation of the vital sign observation, e.g., normal, abnormal, high, etc	
14.07	Vital Sign Result Reference Range	Reference range(s) for the vital sign observation	

Not easy to learn…

```xml
<observation classCode="OBS" moodCode="EVN">
<templateId root="2.16.840.1.113883.3.88.11.83.15" … />
<templateId root="2.16.840.1.113883.10.20.1.31"  … />
<templateId root="1.3.6.1.4.1.19376.1.5.3.1.4.13"  … />
<!-- Result observation template   -->
<id root="107c2dc0-67a5-11db-bd13-0800200c9a66" />
<code code="30313-1" codeSystem="2.16.840.1.113883.6.1" displayName="HGB" />
<statusCode code="completed" />
<effectiveTime value="200003231430" />
<value xsi:type="PQ" value="13.2" unit="g/dl" />
<interpretationCode code="N" codeSystem="2.16.840.1.113883.5.83" />
<referenceRange>
<observationRange>
<text>M 13-18 g/dl; F 12-16 g/dl</text>
</observationRange>
</referenceRange>
</observation>
```

M 13-18 g/dl; F 12-16 g/dl

No Small Change for the Health Information Economy

Kenneth D. Mandl, M.D., M.P.H., and Isaac S. Kohane, M.D., Ph.D.

Four Propositions

(1) **Liquidity of data**. The platform and its applications should reduce impediments to the transfer of data, in an agreed-upon form, from one system to another.

(2) **Substitutability of applications**. The system should be sufficiently modular and interoperable so that ... just as consumers may swap out applications on their iPhones, physicians should be able to readily replace one ... system with another.

(3) **Platform should be built to open standards** accommodating both open-source and closed-source software.

(4) **Platform that supports diverse applications** will lead to a robust health information economy ... by allowing competition and "natural selection" for high-value, low-cost products.
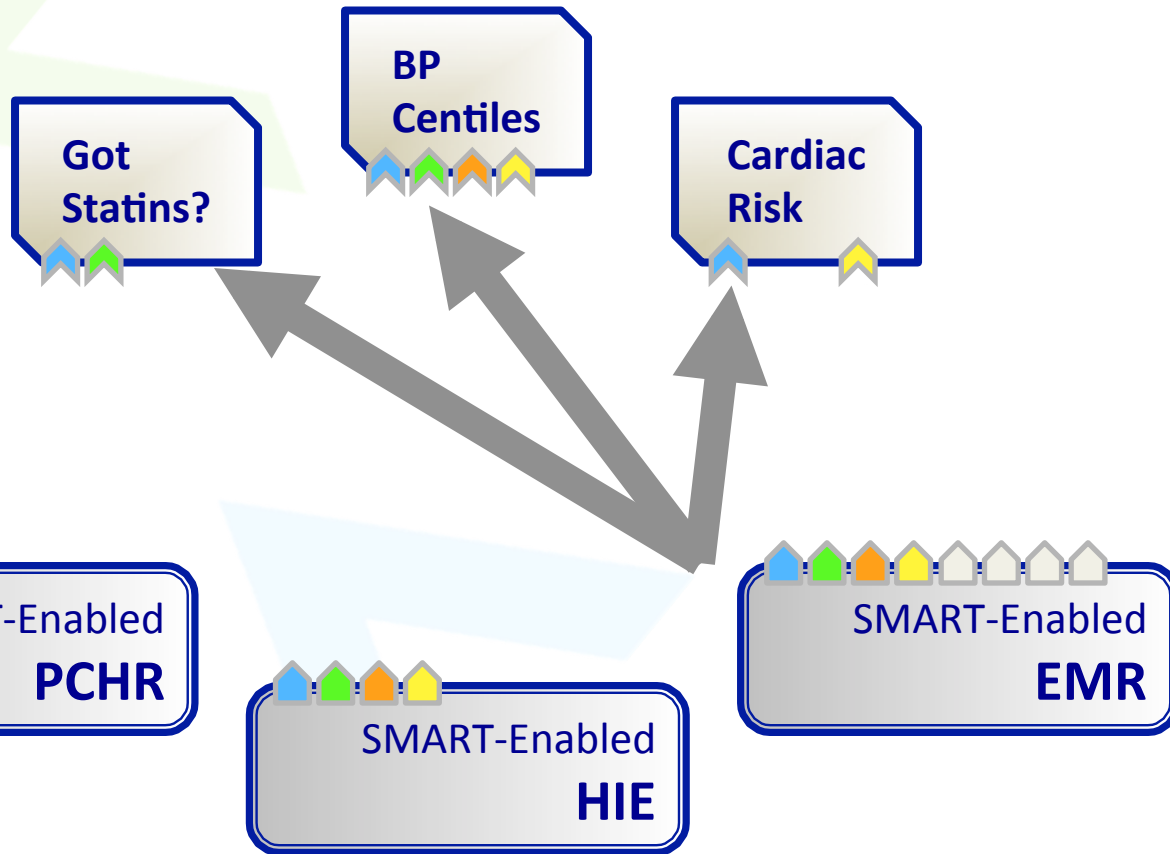
SMART Vocabulary

Apps

Got Statins?

BP Centiles

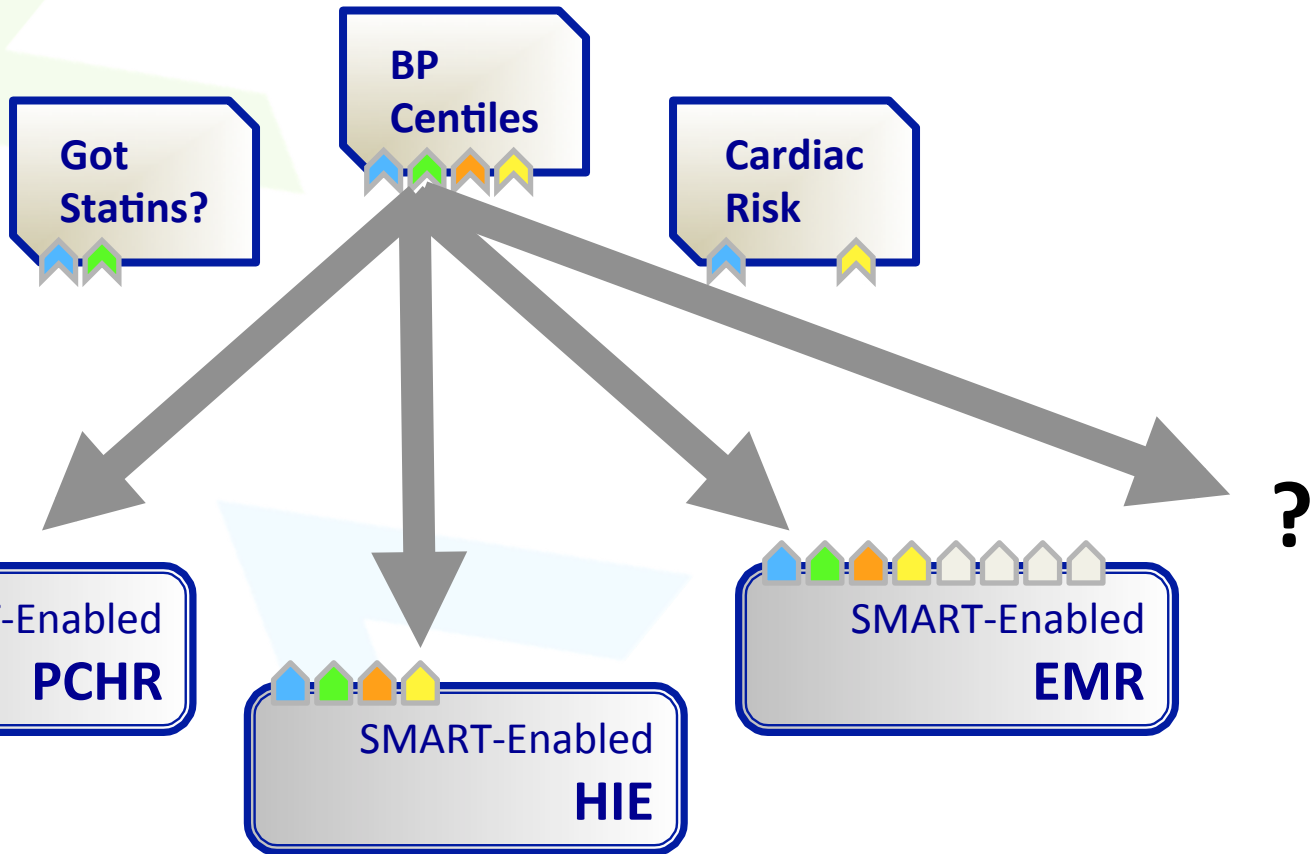Cardiac Risk

API

Containers

SMART-Enabled **PCHR**

SMART-Enabled **HIE**

SMART-Enabled **EMR**

Substitutability = choice

Apps

Got Statins?

BP Centiles

Cardiac Risk

SMART-Enabled **PCHR**

SMART-Enabled **HIE**

SMART-Enabled **EMR**

Containers

Substitutability = re-use

Apps

Got Statins?

BP Centiles

Cardiac Risk

SMART-Enabled **PCHR**

SMART-Enabled **HIE**

SMART-Enabled **EMR**

?

Containers

Substitutable Apps need

UI
Standards-based integration (HTML5)

Data
Context (patient, user, server)
Medical (Problems, Allergies, …)

API
Resource oriented (everything gets a **URL**)

Authentication
Delegated with Web standards (OAuth)

Substitutable Apps need

UI

HTML5

SMART EMR — *Patient John Smith*

Allergies **<iframe**
Labs *src*='http://myapp.com'
Meds **/>**
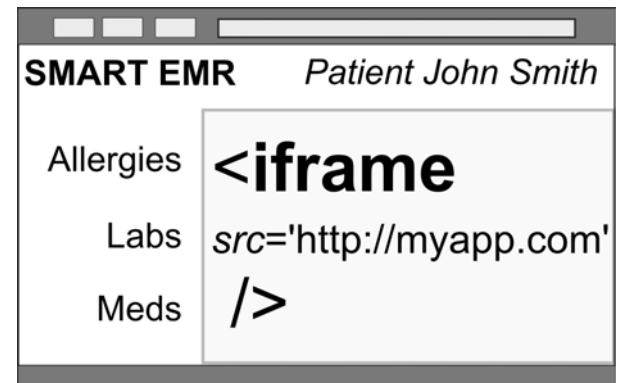
Substitutable Apps need

Data

context, medical data

Substitutable Apps need

Data

"The best way to manage and store data for advanced data-analytical techniques is to break data down into the smallest individual pieces that make sense to exchange or aggregate."

-PCAST Report on Health IT

Substitutable Apps need

Data

leveraging standard **terminology**
... simplifies our own models
(SNOMED CT, RxNorm, LOINC...)

SMART data model

80/20 approach
   e.g., concentrate on common outpatient data

Specify payloads in standard **medical** nomenclatures
   e.g. SNOMED

Extensible semantic representations in RDF
   Ideal for iterative construction over time

Common outpatient data

Alert
Allergy
Allergy Exclusion
Demographics
Encounter
Fulfillment

Lab Result
Medical Record
Medication
Problem
SMART Statement
Vital Signs

Data principles

Translate **local** codes into **medical nomenclature** (keeping provenance)

Medications: **RxNorm** (SCD, SBD, Packs)

Problems: **SNOMED CT**

Labs: **LOINC**

SMART data model example

A **Problem** instance (SMART RDF)

```
<sp:Problem>
 <sp:problemName>
  <sp:CodedValue>
   <sp:code rdf:resource="http://www.ihtsdo.org/snomed-ct/concepts/161891005"/>
   <dcterms:title>Backache (finding)</dcterms:title>
  </sp:CodedValue>
 </sp:problemName>
 <sp:onset>2007-06-12</sp:onset>
 <sp:resolution>2007-08-01</sp:resolution>
</sp:Problem>
```

SNOMED CT

SMART data model example

A **Lab Result** instance (SMART RDF)

```
<sp:labName>

   <sp:CodedValue>
    <sp:code rdf:resource="http://loinc.org/codes/2951-2"/>      ⟵ LOINC
    <dcterms:title>Serum sodium</dcterms:title>
    <sp:codeProvenance>
       <sp:CodeProvenance>
        <sp:sourceCode rdf:resource="http://local-emr/labcodes/01234" />   ⟵ Local
        <dcterms:title>Random blood sodium level</dcterms:title>
        <sp:translationFidelity
            rdf:resource="http://smartplatforms.org/terms/code/fidelity#automated" />
       </sp:CodeProvenance>
      </sp:codeProvenance>
    </sp:CodedValue>
</sp:labName>
```

Substitutable Apps need

API

everything gets a **URL**
("**Resource** oriented")

SMART API principle (REST)

1 URI per patient data element
Each URI maps to *underlying* container

John Smith:
http://smart-emr.hospital.org/records/123

John Smith's atorvastatin:
http://smart-emr.hospital.org/records/123/medications/456

Substitutable Apps need

Authentication

Consistent delegation with Web standards (OAuth)

Authentication

SMART authenticates **1** way – using **OAuth**

widely used web standard to delegate access

Each HIT system authenticates its own way

So containers must implement **OAuth**

HIE: app platform with *reach*

Clinical data

Labs, demographics, encounters – and growing

Context

Point-of-care interactions

Alongside or *instead of* EHR

Subscription model

Established community

Functionality *decoupled* from EHR vendors

Example: Behavior change apps

The next 3 months…

At follow-up

Weight: 165 ↓
BP: 135/85 ↓
LDL: 98 ↓
A1c: 7.5% ↓
Tobacco: No ↓
Aspirin: Yes

Normal Risk ↓
(improved)

Agreed To Goals:
Weight: 160
Diet: More greens
Exercise: 30m x 3w

http://point-of-care.smartdm.org

Patient-supplied Data

SMART Clinical Data:
LDL, A1c, BPs

REDWOOD MEDNET

"Merge" App Architecture
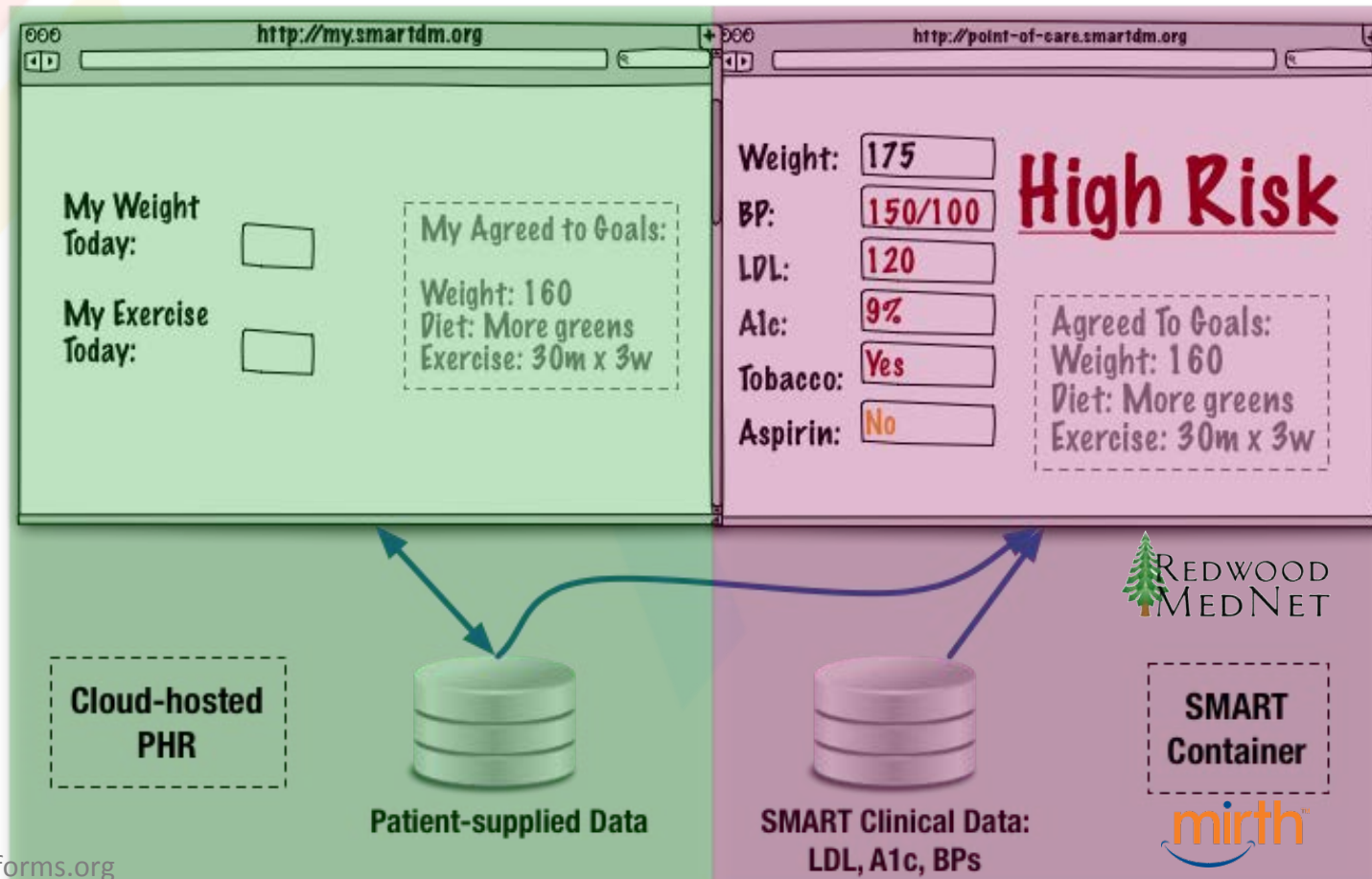
Call to action!

1. Embrace HIE as app platform
Point-of-care *clinical* tools

2. Make it SMART
http://smartplatforms.org

3. Or bring your own API...
But let the data flow.

Thanks!

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