FHIR and Interoperability

Partners in Interoperability
March 21, 2017
Stanley M. Huff, MD
Each EHR vendor uses a proprietary database schema, proprietary models and unique terminology to represent clinical data
• Some standardization of codes is now occurring, but
• Data is not consistent vendor to vendor, or even organization to organization within the same vendor

This means that:
• Sharing data is difficult
• Sharing executable software across vendors is impossible
• Each useful application is created or re-created on each different platform (and we pay for it!)
• There are unmet needs for health care applications and decision support
• Software costs are higher than they need to be
The path to interoperability
What is HL7 FHIR®?

- A set of modular components called “Resources”
- Resources refer to each other using URLs
  - Build a web to support healthcare process
- Exchange resources between systems
  - Using a RESTful API (e.g. web approach)
  - As a bundle of resources (messages, documents)
FHIR: Core Resources

Observation Resource

Observation (DomainResource)

identifier: Identifier [0..*]
status: code [1..1] « ObservationStatus! »
code: CodeableConcept [1..1] « LOINC »
subject: Reference [0..1] « Patient|Group|Device|Location »
encounter: Reference [0..1] « Encounter »
effective[x]: Type [0..1] « dateTime|Period »
value[x]: Type [0..1] « Quantity|CodeableConcept|string|Range|Ratio|SampledData|Attachment »
interpretation: CodeableConcept [0..1] « Observation Interpretation+ »
method: CodeableConcept [0..1] « Observation Methods?? »
specimen: Reference [0..1] « Specimen »
device: Reference [0..1] « Device|DeviceMetric »

Observation

subject: Doe, John; #12345
code: 8480-6, Systolic BP
code: value: 120 mmHg
Profile for “Blood pressure”

**Observation = Blood Pressure**
Subject.reference: Patient URL
Coding: LOINC 55284-4

Related:
- type: has-component
target.reference: Observation URL
- type: has-component
target.reference: Observation URL

**Observation = Systolic BP**
name: “Systolic”
coding: LOINC 8480-6
value.units: “mmHg”

**Observation = Diastolic BP**
name: “Diastolic”
coding: LOINC 8462-4
value.units: “mmHg”
Graphic of a Detailed Clinical Model

SystolicBPObs
- data: 138 mmHg
- qals
  - BodyLocation
    - data: Right Arm
    - PatientPosition
      - data: Sitting

SystolicBP

LOINC or SNOMED Observable

SNOMED CT
People Use LOINC Codes Differently

- Variations on use of methodless and method specific codes
- Confusion on blood versus serum or plasma
- Confusion on properties
- Confusion on NAR vs NOM
- Etc.
## LOINC Codes for Blood Pressure

The search for blood pressure codes generated 465 hits in 0.028 seconds.

<table>
<thead>
<tr>
<th>LOINC</th>
<th>LongName</th>
<th>Component</th>
<th>Property</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>76532-1</td>
<td>Blood pressure device Cuff pressure</td>
<td>Cuff pressure</td>
<td>Pres</td>
<td>Pt</td>
</tr>
<tr>
<td>8470-7</td>
<td>Diastolic blood pressure 10 hour mean</td>
<td>Intravascular diastolic</td>
<td>Pres</td>
<td>10H^meas</td>
</tr>
<tr>
<td>8471-5</td>
<td>Diastolic blood pressure 12 hour mean</td>
<td>Intravascular diastolic</td>
<td>Pres</td>
<td>12H^meas</td>
</tr>
<tr>
<td>8468-1</td>
<td>Diastolic blood pressure 1 hour mean</td>
<td>Intravascular diastolic</td>
<td>Pres</td>
<td>1H^meas</td>
</tr>
<tr>
<td>8472-3</td>
<td>Diastolic blood pressure 24 hour mean</td>
<td>Intravascular diastolic</td>
<td>Pres</td>
<td>24H^meas</td>
</tr>
<tr>
<td>8469-9</td>
<td>Diastolic blood pressure 8 hour mean</td>
<td>Intravascular diastolic</td>
<td>Pres</td>
<td>8H^meas</td>
</tr>
<tr>
<td>8488-9</td>
<td>Diastolic blood pressure 10 hour mean</td>
<td>Intravascular systolic</td>
<td>Pres</td>
<td>10H^meas</td>
</tr>
<tr>
<td>8489-7</td>
<td>Diastolic blood pressure 12 hour mean</td>
<td>Intravascular systolic</td>
<td>Pres</td>
<td>12H^meas</td>
</tr>
</tbody>
</table>
No true interoperability because
- Vendors use different models/profiles
- Government agencies use different models/profiles
- Provider organizations use different models/profiles
- Professional organizations use different models/profiles
CIMI

• The Clinical Information Modeling Initiative (CIMI) is an HL7 Work Group that is producing detailed clinical information models to enable interoperability of health care information systems

• CIMI was initiated during a “Fresh Look” session at an HL7 meeting in 2011

• CIMI models are free for use for all purposes

• See http://www.opencimi.org/ for more details
CIMI Goals

- Create a shared repository of detailed clinical information models
- Repository is open to everyone and models are licensed free for use at no cost
- Where the models:
  - Are expressed in an approved formalism
  - Archetype Definition Language (ADL)
  - Archetype Modeling Language (AML)
  - Are based on a core reference model, including a set of base data types
  - Have formal bindings to standard coded terminologies
CIMI Model Development Lifecycle

**Standards Infusion**

- CIMI RM
- SOLOR

**Initial Loading of Repository**

- CEMs
- DCMs
- CDA Templates
- openEHR Archetypes
- ISO EN 13606 Archetypes
- FHIM
- FHIR Resources

**Model Review**

- Repository of Shared Models in an approved Formalism

**Model Submission**

- Translators
  - CEM
  - DCM
  - UML
  - HTML
  - V2 XML
  - V3 XML
  - FHIR
  - AML
  - ADL
  - CDA
  - OWL
  - SOA Payload
  - CEN Archetype
  - CDISC SHARE

**Model Dissemination**

- Localization & Context Specialization
How to Get Involved

• HL7
  • Partners in Interoperability
    • October 18, 2016 Johns Hopkins University, Baltimore
    • Standardizing data across medical specialties
  • Argonauts
    • Working on implementation of SMART on FHIR services
    • http://argonautwiki.hl7.org/index.php?title=Main_Page

• Healthcare Services Platform Consortium
  • https://healthservices.atlassian.net/wiki/display/HSPC/Healthcare+Services+Platform+Consortium
  • Joint project with ACOG and the Office of Population Affairs
  • Meeting on SOA architecture, knowledge sharing, terminology and modeling
    • November 7, 2016 New Orleans
Options for How to Do the Hard Work
SMART on FHIR® – Open Platform Architecture

SOA Orchestration

mHealth

OAuth

FHIR® REST API

FHIR Profiles from CIMI models

The Hard Work of Standardizing

Cerner
Booth# 6965

Intermountain Healthcare
Booth# 3903

Epic

Others...

http://smartplatforms.org/smart-on-fhir/
IsoSemantic Models – Example of Problem

(from Dr. Linda Bird)

e.g. “suspected lung cancer”
Data Comes in Different Shapes and Colors

Finding – Suspected Lung Cancer

Finding – Suspected Cancer
Location – Lung

Finding – Cancer
Location – Lung
Certainty – Suspected

(Let’s say this is the preferred shape)
Data Standardized in the Service

Application

Data in preferred shape and color

Shape and color translation

Shape and color of data in the local database

Application and User
Partial Interoperability

Application and User

Standard Terms (Non-standard Structure)

Term Translators

Local databases, CDA, HL7 V.2, etc.
Preferred Strategy – Full Interoperability

Application

Application and User

Standard Structure
AND Standard Terms
(As defined by CIMI Models)

Term and Structure
Translators

Local databases,
CDA, HL7 V.2, etc.
Reasons to do it on the server side

• Person writing the translation is most likely to understand the meaning of the data in their own database.
• The person writing the translation only has to understand their own data and the preferred model.
  • They can optimize query execution for their own system
• The query for the data is simpler. If the application has to write a query that will work for all shapes, the query will be inefficient to process by every system.
QUESTIONS?

Stan.Huff@imail.org
The Interoperable App Development Process

**Domain Analysis**

**Create Logical Models (CIMI)**

**Approve Models**

**Model Repository**

**Create Physical Artifacts (FHIR Profiles)**

**Artifact Repository (FHIR Profiles)**

**Project Needs**
- Pediatric Growth Chart
- Neonatal Bilirubin
- Comm Acq Pneumonia
- OPA Data Collection
- MQIP
- ACC registries

**Terminology Server (SOLOR)**

**Conformance Testing**

**Create Software (Apps, Services, CDS)**

**HSPC**

**HSPC+**

**CIMI**
# Model Repository and Model Adoption

## Model Repository

<table>
<thead>
<tr>
<th>Model Id</th>
<th>Status</th>
<th>Version</th>
<th>Isosemantic</th>
<th>Model content</th>
<th>Meta data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematocrit</td>
<td>DSTU</td>
<td>2</td>
<td>2123</td>
<td>XXXX</td>
<td>YYY</td>
</tr>
<tr>
<td>Blood Pressure</td>
<td>Incomplete</td>
<td>1</td>
<td>4578</td>
<td>XXXX</td>
<td>YYY</td>
</tr>
<tr>
<td>Heart Rate</td>
<td>In Use</td>
<td>3</td>
<td>4190</td>
<td>XXXX</td>
<td>YYY</td>
</tr>
<tr>
<td>White Cell Count</td>
<td>In Use</td>
<td>5</td>
<td>1789</td>
<td>XXXX</td>
<td>YYY</td>
</tr>
<tr>
<td>Serum Glucose</td>
<td>DSTU</td>
<td>2</td>
<td>3675</td>
<td>XXXX</td>
<td>YYY</td>
</tr>
<tr>
<td>Serum Bilirubin</td>
<td>In Use</td>
<td>3</td>
<td>5367</td>
<td>XXXX</td>
<td>YYY</td>
</tr>
</tbody>
</table>

## Model Adoption

<table>
<thead>
<tr>
<th>Model Id</th>
<th>Realm</th>
<th>Use Case</th>
<th>Meta data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Rate</td>
<td>US</td>
<td>Public Health Reporting</td>
<td>YYY</td>
</tr>
<tr>
<td>Hematocrit</td>
<td>AUS</td>
<td>Standard Lab Results</td>
<td>YYY</td>
</tr>
<tr>
<td>Serum Glucose</td>
<td>US</td>
<td>MU Quality Measure</td>
<td>YYY</td>
</tr>
<tr>
<td>Serum Glucose</td>
<td>International</td>
<td>CIMI</td>
<td>YYY</td>
</tr>
<tr>
<td>Serum Glucose</td>
<td>International</td>
<td>openEHR</td>
<td>YYY</td>
</tr>
<tr>
<td>Serum Bilirubin</td>
<td>HSPC</td>
<td>Neonatal Bilirubin App</td>
<td>YYY</td>
</tr>
</tbody>
</table>
Healthcare Services Platform Consortium

MISSION

Improve health by creating a vibrant, open ecosystem of interoperable applications, content, and services.
HSPC Initiatives

- Be a provider led collaboration agent
- Create a reference implementation of common SOA
- Develop terminology and information models for true semantic interoperability
- Support authoring and sharing of knowledge content
- Obtain implementation and adoption of approved standards
- Create a shared technical environment to enable simple and efficient development
We are **not** proposing any changes to existing HL7 interfaces

We support everything that is being done by the Argonauts

This is a coalition of folks that want to realize the value of true plug-and-play interoperability by use of very explicit FHIR profiles

One step (application) at a time
  * Not trying to boil the ocean