Conflict of Interest

Stanley M. Huff, MD

Has no real or apparent conflicts of interest to report.
Conflict of Interest

David McCallie, MD

Is an employee of Cerner, but otherwise has no real or apparent conflicts of interest to report.
Learning Objectives

1. Describe how to enable the integration of applications directly into the EHR's workflow.
2. Apply FHIR standards to precisely define how to encode the most commonly used data entities.
3. Assess the impact of the SMART platform approach on the pilot programs.
An Introduction to the Benefits Realized for the Value of Health IT

SMART on FHIR leverages current EHR platforms to create sustainable apps built to function with the EHR to create smarter, more meaningful date and interfaces.
Current Situation

• Each EHR vendor uses proprietary models and 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 of data is difficult
  – Sharing of executable software across vendors is impossible
  – Each useful application is created or re-created on each different platform
  – There are unmet needs for health care applications and decision support
  – Software costs are higher than they need to be
EHR as Platform: Market Forces

“EHRs are becoming commodity platforms. The winner will be the EHR vendor that provides the best platform for innovation – the most open and most extensible platform.”
--- CEO of a major IDN

- Self determination – ability to meet own needs
- Desire for vendor independence
- Don’t want to rely on proprietary extensions or process
- Need clean separation of IP rights (commercialization)
EHR as Platform: Government Forces

**JASON Report:** “A Robust Health Data Infrastructure”
- Use “atomic” data elements, not just documents
- Require EHRs (vendor/provider) to expose “open” APIs
- Dismissive of current (MU1 & MU2) efforts
- Design systems for research uses, not just clinical care
- Focus on “Apps” not monolithic solutions
- Give the patient more control over uses of his data
JASON Task Force – Recommendations

• A Coordinated National Architecture
  – Modeled on Internet principles (loose coupling) for scale
• Data Sharing Arrangements (DSA) for governance

• **All EHRs should deploy a “Public API”**
  – Implement “Core Data Services & Profiles” – FHIR
  – Expectation to deploy the API
  – Permit non-discriminatory access to the API

• API becomes part of CEHRT

• Measures and transparency for usage of the APIs
EHR as Open Platform

• EHR becomes a Platform - responsible for:
  – User and patient management
  – Core transactional services (orders, documentation, etc.)
  – Workflow
  – Legal record

• Use “Public API” to support “Apps” that can extend EHR functionality
  – No single vendor can supply every needed function
  – App cans plug in to the clinical workflow
  – A new channel for informatics researchers
  – A new ecosystem for innovative App developers
Candidate Open Platform: SMART + FHIR

What standards are needed for an Open EHR Platform?

“Substitutable Medical Applications and Reusable Technology”
“Fast Health Interoperability Resources”
Some SMART Hotbeds
SMART on FHIR® at HIMSS 14

Harris Corporation
Intermountain
Cerner
HP (VistA) Intelligent Hospital

Inter Operability Showcase
SMART on FHIR – Open EHR Platform (HIMSS Demo)

Clinical Element Models & FHIR Data Profiles

SOA Orchestration

mHealth

OAuth

FHIR REST API

Exhibiting Health IT Systems

Cerner

Booth# 6965

Intermountain Healthcare

Booth# 3903

HARRIS

Booth# 1164

HP

Booth# 1949

http://smartplatforms.org/smart-on-fhir/
HL7 FHIR™ – The “Public API” for Healthcare?

FHIR = Fast Health Interoperability Resource

- Emerging HL7 Standard (DSTU 2 soon)
- More powerful & less complex than HL7 V3

ReSTful API

- ReST = Representational State Transfer – basis for Internet Scale
- Resource-oriented rather than Remote Procedure Call (nouns > verbs)
- Easy for developers to understand and use

FHIR Resources

- Well-defined, simple snippets of data that capture core clinical entities
- Build on top of existing HL7 data types
- Resources are the “objects” in a network of URI reference links
FHIR: Core Resources

- AdverseReaction
- Alert
- AllergyIntolerance
- CarePlan
- Composition
- ConceptMap
- Condition
- Conformance
- Device
- DeviceObservationReport
- DiagnosticOrder
- DiagnosticReport
- DocumentReference
- DocumentManifest
- Encounter
- FamilyHistory
- Group
- ImagingStudy
- Immunization
- ImmunizationRecommendation
- List
- Location
- Media
- Medication
- MedicationAdministration
- MedicationDispense
- MedicationPrescription
- MedicationStatement
- MessageHeader
- Observation
- OperationOutcome
- Order
- OrderResponse
- Organization
- Other
- Patient
- Practitioner
- Procedure
- Profile
- Provenance
- Query
- Questionnaire
- RelatedPerson
- SecurityEvent
- Specimen
- Substance
- Supply
- ValueSet
Example: Fetch a systolic blood pressure

GET https://open-api.fhir.me/Observation/8567?_format=json

```json
{
    "resourceType": "Observation",
    "text": {
        "status": "generated",
        "div": "1999-07-02: Systolic blood pressure = 109 mm[Hg]"
    },
    "name": {
        "coding": [
            {
                "system": "http://loinc.org",
                "code": "8480-6",
                "display": "Systolic blood pressure"
            }
        ]
    },
    "valueQuantity": {
        "value": 109.0,
        "units": "mm[Hg]",
        "code": "mm[Hg]"
    },
    "appliesDateTime": "1999-07-02",
    "status": "final",
    "subject": {
        "reference": "Patient/1186747"
    }
}
```
Profile for “Blood pressure”

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

Related:
- 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”
Evolution of Clinical Modeling & FHIR Profiling

• Clinical Element Models (CEM)
  – Curated by Stan Huff at Intermountain
  – 6500+ semantically-complete, explicitly constrained data entities
  – http://www.clinicalelement.com/

• CIMI – emerging international standard modeling effort
  – Led by Stan Huff and many others

• HSPC - Healthcare Services Platform Coalition
  – Intermountain + Harris + many others

• Argonauts
  – Vendor group to fund speed up SMART and FHIR
  – HL7 FHIR Core + Argonaut Profiles + OAuth2
  – Due in May, 2015
CIMI - Future Profiling Process

- Standard Terminologies
- CIMI Models
- Intermountain CEMs
- HL7 FHIR Resources
- openEHR Archetypes
- Translator (or manual)

HSPC approved HL7 FHIR Profiles
HL7 FHIR Resources and Profiles

FHIR Resource

Observation

Lab Obs

Patient Obs

Family Hx Obs

Qn Lab Obs

Qual Lab Obs

Titer Lab Obs

Hematocrit

Serum Glucose

Urine Sodium

Invariant Profile Structure – ClMI Leaf Node Content
HSPC Meeting Participants (~50)

- FHIR – Grahame Grieve
- SMART – Josh Mandel
- Cerner – David McCallie
- Epic – Janet Campbell
- Allscripts – Surj Ramlogan
- Siemens – Carmela Couderc
- VA – Keith Campbell
- openEHR – Thomas Beale
- OHT – David Carlson
- Harris
- Intermountain Healthcare
- Wes Rishel
- ASU – Aziz Boxwalla

- Systems Made Simple
- Lantana – Yan Heras
- Center for Medical Interoperability – Todd Cooper
- Relay Health – Arien Malec
- NLM – Clem McDonald
- Infocare Healthcare – Herb White
- Mayo Clinic – Cris Ross, Chris Chute
- Clinical Architecture – Shaun Shakib
- Cognitive Medical Systems – Doug Burke
SMART Platform – Open Specification for Apps

• “Substitutable Medical Apps”

• A SMART App is a Web App
  – HTML5 + JavaScript
  – Remote or embedded in EHR
  – URL passes context & FHIR link

• EHR Data Access via FHIR

• OAuth2 / OIDC for security
App Invocation – Sequence Diagram

Millennium  |  MPage (IE)  |  App  |  Authorization Service  |  FHIR Service (Millennium Data)

**Menu or Discern**

App URL + EHR context + URL of Auth/FHIR

**Request authorization**

Validate user and patient context against Millennium

**Returns auth token**

Token + FHIR request for patient data

**Returns patient data**

HTML + JS (UX)

**POST user input**

Token + FHIR request for more patient data

**Returns patient data**

HTML + JS (UX)

**DONE**
Open Is Happening

Semantics Interoperability

Open Is Happening

Boston Children’s SMART Growth Chart

Intermountain’s Bilirubin App

Geisinger’s Rheumatology App

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Copyright © 2014 IHC Health Services, Inc. All Rights Reserved.

Copyright © 2014 Geisinger Health System. All Rights Reserved.
SMART Growth Chart

CARRIE DEMORA
sex: female
dob: 21Nov2005
age: 8y 3m

Length/Stature (cm)
121.6cm 70%

Weight (kg)

BMI
HEAD C

CDC
Girl, 0 - 20y

TOC
Ambulatory Summary
Ambulatory Summary (FHIR)
Results Review
Diagnosis & Problems
Health Maintenance
Documentation
Tasks
Allergies
Growth Chart
Histories
Immunization Schedule
MAR Summary
Medication List
Notes
Patient Information
Form Browser
MAR
SMART Growth Chart
SMART BP Centiles
SMART Medication
SMART Visual Dx
SMART Bilirubin Tool
SMART FHIR Demo

App Version: 0.9.5-beta

NICU OFF % Z kg/cm lb/ft

0 – 20 Years

0 – 2 Years

0 – 6 Months

0 – 13 Weeks

0 – 20 Years

NICU OFF % Z kg/cm lb/ft

0 – 20 Years

0 – 2 Years

0 – 6 Months

0 – 13 Weeks

NICU OFF % Z kg/cm lb/ft

0 – 20 Years

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NICU OFF % Z kg/cm lb/ft

0 – 20 Years

0 – 2 Years

0 – 6 Months

0 – 13 Weeks

NICU OFF % Z kg/cm lb/ft

0 – 20 Years

0 – 2 Years

0 – 6 Months

0 – 13 Weeks
SMART Growth Chart – Parent’s View

CARRIE DEMORA
sex female
dob 21Nov2005
age 8y 3m

SMART Growth Chart

25Jun2012 6y 7m
64cm | 72%
13.4kg | 92%
N/A
N/A

Underweight
Healthy
Overweight
Obese

CARRIE DEMORA is overweight at 34.4 kg (75lb 13 oz).
Compared to her last weight assessment, she is at risk for becoming obese.
Intermountain: SMART Neonatal Bilirubin Alerts

CARRIE DEMORA
sex Female
dob 21 Nov 2005
age 8y 3m 6d

Hour Specific Bilirubin Risk Chart for Term & Near-Term Infants with NO Additional Risk Factors

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Result</th>
<th>Age (Hrs)</th>
<th>Value: Test</th>
<th>Risk Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/21/2005</td>
<td>4.5</td>
<td>6.00</td>
<td>Bill Meter</td>
<td>High Intermediate Risk Zone (75-95%)</td>
</tr>
<tr>
<td>06:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/22/2005</td>
<td>12.5</td>
<td>30.00</td>
<td>Bill Meter</td>
<td>High Risk Zone (&gt;95%)</td>
</tr>
<tr>
<td>06:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12:00</td>
<td>12.6</td>
<td>36.00</td>
<td>Bill Meter</td>
<td>High Risk Zone (&gt;95%)</td>
</tr>
<tr>
<td>11/22/2005</td>
<td>12.8</td>
<td>44.00</td>
<td>Bill Meter</td>
<td>High Intermediate Risk Zone (75-95%)</td>
</tr>
<tr>
<td>20:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/23/2005</td>
<td>11</td>
<td>68.00</td>
<td>Bill Meter</td>
<td>Low Intermediate Risk Zone (40-74%)</td>
</tr>
<tr>
<td>20:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/25/2005</td>
<td>9.8</td>
<td>116.00</td>
<td>Bill Meter</td>
<td>Low Risk Zone (&lt;40%)</td>
</tr>
<tr>
<td>20:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Commercial: VisualDX

Drug Eruption Search: 7 of 7 Medications found in VisualDx

- NIFEdipine 10 mg oral capsule
- Tylenol Extra Strength 500 mg oral tablet
- lisinopril 20 mg oral tablet
- naproxen 500 mg oral tablet
- Cipro 500 mg oral tablet
- Coumadin 4 mg oral tablet
- methotrexate 2.5 mg oral tablet

Diagnosis Search: 7 of 8 Conditions found in VisualDx

- Wegener's granulomatosis
- Legionellosis
Commercial: VisualDx

I. Contents

- ICD Codes
- Synopsis
- Look For
- Diagnostic Pearls
- Differential Diagnosis & Pitfalls
- Best Tests
- Management Pearls
- Therapy
- References
- Associated Medications
- Associated Findings

II. Clinical Scenario

- Acute Pulmonary Infection
- Chem-Bio-Rad Suspicion

III. ICD Codes

ICD-9-CM:
- 482.84 – Pneumonia due to legionnaires’ disease

ICD-10-CM:
- A48.1 – Legionnaires’ disease

IV. Synopsis

Legionellosis is caused by Legionella pneumophila, a small gram-negative bacillus found in aqueous environments in a wide variety of habitats at temperatures ranging from 5-50 degrees Celsius.

Almost all cases of legionellosis are a result of inhalation of aerosolized bacteria residing in warm, man-made water bodies such as water heaters, air-conditioning equipment, cooling towers, warm-water baths, warm-water plumbing systems, and recirculating water systems. Contamination of such water systems in hospitals has lead to nosocomial outbreaks of disease.

The occurrence of disease is dependent on the simultaneous existence of a virulent strain, environmental conditions permitting survival and aerosolization of bacteria, and a susceptible host. Legionellosis (also known as Legionnaires’ disease) is believed to occur throughout the world, with 8,000-18,000 cases occurring each year in the United States. About a quarter of these originate in a hospital environment and are associated with a higher proportion of fatalities. Most cases are sporadic. Less than one fifth of all cases are associated with an outbreak.
What kind of Apps are likely to appear?

- Decision support
  - Complex or evolving logic
  - Visualization
- Patient -- Provider data sharing
  - Simultaneous provider’s view & patient view
- Integration of external data into EHR workflow
  - Population Health – bilateral data flow
  - “Real time” HIE integration
- National scale services
  - Genomics (Smarter ordering, PGX, etc.)
- mHealth / mobile apps
  - Connecting consumer apps to their EHR data!
  - Counterpart to Apple’s HealthKit?
- Informatics Research
  - Clear IP rights (vs. source code approaches)
  - Local or multi-site
Like Google Maps...

Apps that address specific focused problems...

- Provider-facing services
  - Focused decision support
  - Visualization
  - Disease management
  - Specialty workflows

- National Shared Services
  - Genomic testing & CDS
  - Pharmacogenomic screening
  - CDC Ebola screening?
  - CDC immunization forecaster
  - Prior Authorization / Appropriateness
Like Facebook...

Apps that enable data sharing...

- Next-gen Interoperability
  - Population Health integration
  - HIE integration
  - Data capture for research
  - Clinical Trial recruiting
Apps that empower patients / consumers...

- Apps as Prescriptions
  - Chronic disease management
  - Pt-Provider Communication
  - Remote monitoring
  - Outcome capture & Clinical Effectiveness Monitoring
A Review of Benefits Realized for the Value of Health IT

SMART on FHIR leverages current EHR platforms to create sustainable apps built to function with the EHR to create smarter, more meaningful data and interfaces.
Questions

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