FHIR, SMART & HSPC

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The Big Picture

- Ubiquitous Plug-n-play Semantic Interoperability
- Be able to share data, applications, reports, alerts, protocols, data entry screens, and decision support modules with anyone
A Few Examples

• Integration of best of breed clinical applications into existing, deployed EMRs.
  • Geisinger’s Rheumatology application
  • SMART’s Growth Chart application

• Decision support services
  • Provide the same guidance regardless of the application used to view the data

• Care Coordination
  • Seamless scheduling between providers with different EHRs

• Clinical Research, Quality Measures, Registries
  • Distribution of EHR-agnostic applications to collect and calculate data rather than distribution of paper descriptions
FHIR
HL7 FHIR™

- Fast
- Healthcare
- Interoperability
- Resources
HL7 FHIR ™

• HL7 V2
  • Well established in certain domains (e.g. lab)
  • Doesn’t provide much semantic support
  • Doesn’t take advantage of more modern technologies

• HL7 V3 (including CDA)
  • Strong semantics
  • Complex (too much so)

• FHIR
  • Clean slate approach
  • Enables strong semantics (but doesn’t guarantee it)
  • Modern technologies (looks familiar to outsiders)
Timeline: Where does FHIR fit?

- **V2**: 1987
- **Start V3**: 1995
- **V3 CDA**: 2005
- **Fresh Look DSTU**: 2011
- **FHIR DSTU**: 2014

- **10 years**: 1995 to 2005
- **3 years**: 2011 to 2014
FHIR Principles

- A strong focus on implementation
- Many implementation libraries and examples
- Free for use with no restrictions
- Out-of-the-box interoperability (at the resource level)
- Informed by V2 and V3/CDA
- Foundation in web standards (XML, JSON, HTTP, etc.)
- Support for RESTful architectures
- Concise and easily understood specifications
- Human-readable wire format (for developer ease)
Paradigms

- FHIR supports 4 interoperability paradigms
REST

• “Representational state transfer” – an architecture for how to connect systems
• CRUD
• Outcomes
  • Simple stable interfaces
  • High Performance / Scalability
  • Visible Process (e.g. can debug)
  • Portability
  • Reliability (resistance to failure)
- Similar to CDA
- Collection of resources bound together
  - Root is a “Composition” resource
  - Just like CDA header
- Sent as a bundle
- One context
- Can be signed, authenticated, etc.
Message

• Similar to v2 and v3 messaging
• Also a collection of resources as a bundle
• Allows request/response behavior with bundles for both request and response
• Event-driven
  • E.g. Send lab order, get back result
• Can be asynchronous
Service Oriented Architecture (SOA)

- Do whatever you like
  - (based on SOA principles)
  - Ultra complex workflows
  - Ultra simple workflows
  - Individual resources or collections
  - Use HTTP/S or use something else
  - Only constraint is that you’re passing around FHIR resources in some shape or manner
Regardless of **paradigm**
the content is the same

Receive a lab result in a message…

…Package it in a discharge summary document
RESOURCES & PROFILES
Resources

“Resources” are:
- Small logically discrete units of exchange
- Defined behaviour and meaning
- Known identity / location
- Smallest unit of transaction “of interest” to healthcare

- HL7 V2: Sort of like Segments
- HL7 V3: Sort of like CMETs
## What’s a Resource?

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<th>Examples</th>
<th>Non-examples</th>
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<td><strong>Administrative</strong></td>
<td><strong>Gender</strong></td>
</tr>
<tr>
<td>• Patient, Practitioner, Organization, Location, Coverage, Invoice</td>
<td>• Too small</td>
</tr>
<tr>
<td><strong>Clinical Concepts</strong></td>
<td><strong>Electronic Health Record</strong></td>
</tr>
<tr>
<td>• Allergy, Condition, Family History, Care Plan</td>
<td>• Too big</td>
</tr>
<tr>
<td><strong>Infrastructure</strong></td>
<td><strong>Blood Pressure</strong></td>
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<tr>
<td>• Document, Message, Profile, Conformance</td>
<td>• Too specific</td>
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<td><strong>Intervention</strong></td>
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<tr>
<td></td>
<td>• Too broad</td>
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</table>
Resource anatomy

- Resources have 3 parts

1. Defined
2. Structured Data
3. Narrative
4. Extensions
Example Resource Definitions

Patient (Resource)
- identifier : Identifier 0..*
- name : HumanName 0..*
- telecom : Contact 0..*
- gender : CodeableConcept 0..1 <<AdministrativeGender>>
- birthDate : dateTime 0..1
- deceased[x] : boolean | dateTime 0..1
- address : Address 0..*
- maritalStatus : CodeableConcept 0..1 <<MaritalStatus>>
- multipleBirth[x] : boolean | integer 0..1
- photo : Attachment 0..*
- communication : CodeableConcept 0..* <<Language>>
- careProvider : Resource(Organization | Practitioner) 0..*
- managingOrganization : Resource(Organization) 0..1
- active : boolean 0..1

Animal
- species : CodeableConcept 1..1 <<AnimalSpecies>>
- breed : CodeableConcept 0..1 <<AnimalBreed>>
- genderStatus : CodeableConcept 0..1 <<AnimalGenderStatus>>

Link
- other : Resource(Patient) 1..1
- type : code 1..1 <<LinkType>>

Contact
- relationship : CodeableConcept 0..* <<ContactRelationship>>
- name : HumanName 0..1
- telecom : Contact 0..*
- address : Address 0..1
- gender : CodeableConcept 0..1 <<AdministrativeGender>>
- organization : Resource(Organization) 0..1
<Patient xmlns="http://hl7.org/fhir">
  <!-- from Resource: extension, narrative, and contained -->
  <identifier><!-- 0..* Identifier An identifier for the person as this patient § --></identifier>
  <name><!-- 0..* HumanName A name associated with the patient § --></name>
  <telecom><!-- 0..* Contact A contact detail for the individual § --></telecom>
  <gender><!-- 0..1 CodeableConcept Gender for administrative purposes § --></gender>
  <birthDate value="[dateTime]"><!-- 0..1 The date and time of birth for the individual § -->
  <deceased[x]><!-- 0..1 boolean|dateTime Indicates if the individual is deceased or not § --></deceased[x]>
  <address><!-- 0..* Address Addresses for the individual § --></address>
  <maritalStatus><!-- 0..1 CodeableConcept Marital (civil) status of a person § --></maritalStatus>
  <multipleBirth[x]><!-- 0..1 boolean|integer Whether patient is part of a multiple birth § -->
  <photo><!-- 0..* Attachment Image of the person --></photo>
  <contact><!-- 0..* A contact party (e.g. guardian, partner, friend) for the patient -->
    <relationship><!-- 0..* CodeableConcept The kind of relationship --></relationship>
    <name><!-- 0..1 HumanName A name associated with the person --></name>
    <telecom><!-- 0..* Contact A contact detail for the person --></telecom>
    <address><!-- 0..1 Address Address for the contact person --></address>
    <gender><!-- 0..1 CodeableConcept Gender for administrative purposes --></gender>
    <organization><!-- 0..1 Resource(Organization) Organization that is associated with the contact -->
  </organization>
</contact>
  <animal><!-- 0..1 If this patient is an animal (non-human) § -->
    <species><!-- 1..1 CodeableConcept E.g. Dog, Cow § --></species>
    <breed><!-- 0..1 CodeableConcept E.g. Poodle, Angus § --></breed>
    <genderStatus><!-- 0..1 CodeableConcept E.g. Neutered, Intact § --></genderStatus>
  </animal>
  <communication><!-- 0..* CodeableConcept Languages which may be used to communicate with the patient -->
</communication>
</Patient>
It’s all about combining resources . . .
References

- Resources are independent – don’t need other resources to correctly interpret a resource
- But resources reference each other extensively to form a web of information
- Need to resolve references to fully understand the data

```
<Procedure xmlns="http://hl7.org/fhir">
  <subject>
    <reference value="Patient/23"/>
  </subject>

  ... 

  <report>
  </report>
```
Extensions

• FHIR has a standard framework for extensions
  • Built into wire format
• Every FHIR element can be extended
  • Including datatypes
• Every extension has:
  • Reference to a computable definition
  • Value – from a set of known types
• Every system can read, write, store and exchange all legal extensions
• All extensions are valid by schema etc.
Extensions

- In FHIR, extensions are “normal”
  - Consequence of the 80% rule – keep the simple stuff simple
  - Extensions can exist anywhere
    - Yes, even inside boolean or date
  - Conformant systems can’t reject instances just because they contain unrecognized extensions
- They could:
  - Display them
    - Should be in resource narrative
  - Store as a ‘Blob’
  - Make a conscious decision to ignore (unless ModifierExtension)
    - (Could lookup profile)
Profiles

• Document constraints and extensions on one or more resources for a Use Case
• May also define new extensions search terms, new messaging events, etc.
• Subsumes: template, implementation profile, DCM (Detailed Clinical Model), etc.
• Looks an awful lot like the definition of the resources themselves
  • You can download profile XML for all resources
Using Profiles

• You can just go ahead and use a resource
  • No need for a profile
• But you should write a profile
  • Document your usage in detail for partners
• You can mark a resource or bundle with a profile
  • It’s just a claim – can test conformance with that
Conformance

• There’s a resource for documenting conformance to FHIR

• Can be used for:
  • Stating how a specific system instance behaves
  • Defining how a software system is capable of behaving (including configuration options)
  • Identifying a desired set of behavior (e.g. RFP)

• To declare themselves “FHIR Conformant”, a system must publish a Conformance instance
Welcome to FHIR®

First time here? Read the high level summary and then the overview, and check FHIR's open license

Major Sections:

- General Documentation
- Implementation & Exchange
- Clinical Resources
- Administrative Resources
- Infrastructural Resources

Quick Links:

- XML & JSON
- REST API
- Data Types
- Codes / Terminologies
- Extensions
- Security
- Resource List
- Common Use Cases
- Full table of contents
- Book Form (all one page)
- Translations: Japanese
- FHIR Wiki
- Downloads
- FHIR Schemas & Schematrons
- Examples: XML, JSON
- Code: XML, C#, Delphi
- Stack Overflow (When to use)
- Public Test Servers & Software

Search the FHIR Specification:
SMART
SMART

• Originated as one of the ONC SHARP grants
• Goal was to create an AppStore-like model for healthcare
• Initially used RDF for data representation
• Now FHIR based
What Does SMART Provide?

• Tools for developers
  • Security profiles (OAuth 2)
  • Identity profiles (OpenID Connect)
  • Application launch context

• Applications
  • [https://gallery.smarthealthit.org/](https://gallery.smarthealthit.org/)
  • E.g. Growth chart, Pediatric BP centiles, Cardiovascular risk factors
  • Many are open source and good examples for developers

• Attention
  • Meetings and publications promoting this approach
More about SMART

- Most of the work is done by a small core team
- Planning a collaboration on a sandbox with HSPC
- Incremental approach (what’s the next thing that would help move this effort forward?)
- Based out of Boston Children’s Hospital and Harvard Medical School
- Not an open participation organization, but they are friendly people who will listen to good ideas.
HSPC
HSPC

- Healthcare Services Platform Consortium
- Provider led, non-profit community promoting interoperable healthcare IT services

Goals

- Vendor-neutral interoperable applications
- Leverage existing standards if possible and appropriate
- Specify interoperable uses of standards
- Promote an robust HIT marketplace
- Make it easy
Principles

• Not-for-profit entity
  • There could be an associated for-profit entity some day
• Provider led
  • Simple majority of providers on the Board of Directors
• All organizations will have equal influence and opportunity
  • Intermountain and LSU will not be “special”
• Start small, be effective, and then grow
  • We want to allow everyone that is interested to participate
• Allow diverse strategies and participants
  • Open source and for-profit
  • One person business up to multi-national corporations
  • Healthcare providers and healthcare software developers
  • Students and professional software engineers
Principles (continued)

- Initially, focus on the minimum set of standards and technology
  - Increase options as we gain experience and success
- HSPC is *not* producing software (mostly)
  - HSPC members or groups of members produce software
  - HSPC will need to provide a reference implementation for purposes of certification
- No “central planning” by HSPC of app development
  - Participants decide what they want to build and invest their own resources
  - We *DO* need to agree about the minimum set of services that will enable a marketplace
Essential Functions of the Consortium

- Select the standards for interoperable services
  - Standards for models, terminology, security, authorization, context sharing, transport protocols, etc.
  - Modeling: SNOMED, LOINC, RxNorm – FHIR Profiles – do it together
  - Publish the models, and development instructions openly, licensed free-for-use
- Provide testing, conformance evaluation, and certification of software
  - Gold Standard Reference Architecture and its Implementation
  - We will work with an established company to provide this service
  - Fees that off set the cost of certification will be charged to those who certify their software
- Implementation of the standard services by vendors against their database and infrastructure
  - Everyone does not have to do every service
  - There must be a core set of services that enable a marketplace
Other Functions of the Consortium

• Participation in “other” functions is optional for a given member
  • Enable development “sandboxes”
    • Could be provided by companies or universities
    • Could be open source or for-profit
  • Set up an actual “App Store”
    • Many companies already have their own app stores
    • Vendor certification that a given application can be safely used in their system
    • Accommodate small companies or individuals that won’t have their own app store
  • Create a business framework to support collaborative development
    • Pre-agree on IP, ownership, co-investment, allocation of revenue
    • Try to avoid unique contracts for each development project
  • Provide a way for people to invest (Venture capital)
Current HSPC Work

• Initial focus on FHIR based services
• Use SMART profiles for OAuth, OpenID Connect and launch context
• Develop interoperable FHIR profiles
• Provide sandbox for developers
• More advanced interoperable services
  • CDS / Eventing / Notification
  • Workflow
• Get people working together
Foundation of Interoperability

Security, Context, Etc.

APIs

Data Models

Terminologies
SMART on FHIR®© – Open Platform Architecture

SOA Orchestration

mHealth

OAuth

FHIR REST API

FHIR Profiles from CIMI Models (using standard terminology)

Heterogeneous Systems

Commercial EHR

Home Grown System

System Integrator

Others…

http://smartplatforms.org/smart-on-fhir/
## HSPC @ HIMSS 2015

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<tr>
<th>App Name</th>
<th>HSPC Sandbox</th>
<th>SMART on FHIR Sandbox</th>
<th>Epic</th>
<th>Cerner</th>
<th>VistA (SMS)</th>
<th>athenahealth</th>
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Developer Support

- [https://healthservices.atlassian.net](https://healthservices.atlassian.net)
  - On the left nav bar “For Developers”
- Sandbox
- Tutorials
- Java Client
Summary

• FHIR
  • Provides the foundational framework for interoperability

• SMART
  • Helps in specification of functionality currently outside the scope of FHIR

• HSPC
  • A community focused on interoperable implementations based on FHIR, SMART and other tools.