HL7 and FHIR: The New Standard for Health Exchange Interoperability

Liora Alschuler, CEO
Rick Geimer, CTO
About Us

Liora Alschuler
- Long-time activist developing, promoting interoperability
- Day job: Lantana CEO

Rick Geimer
- Developer of standards & software, HL7 CDA-on-FHIR Lead
- Day job: Lantana CTO
Agenda

Local Liora
- Standards Landscape 2015
- FHIR in Context

Remote Rick
- FHIR Fundamentals
- Current Work and Status of the Draft Standard

Local Liora
- Is your Roadmap on FHIR?
- Wrap

Both
- Q&A
Standards Landscape 2015

Liora Alschuler
In the Beginning…

Good old HL7 V2
- Proprietary, idiosyncratic syntax
- Fixed field
- Z-segments for extensibility

Did well enough
- Interfaced early administrative, clinical systems with administrative data (ADT)
- Labs – sort of, still struggling with standard coding
- Some registries (immunization, for example)

Did poorly or not at all
- Clinical decision support
- Claims adjudication (attachments)
- Extra-enterprise continuity of care
- Not to mention value-based care
Move to Non-Healthcare-Specific Methods

Extensible Markup Language (XML) introduced to HL7 in 1997
- Industry standard syntax, more OTS tools, validation services
- Modest advance in V2.XML
- Introduced “sparsely populated tree structure” for clinical documents
  - Rich clinical content
  - Narrative & structured data
HL7 Version 3

- Model-based
- XML default syntax
- In theory, one model/syntax/methodology for both messages & documents
### Documents vs. Messages

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<th>Messages</th>
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<td>Persistent</td>
<td>Temporal</td>
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<tr>
<td>Communication</td>
<td>Between people</td>
<td>Between applications</td>
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<tr>
<td>Relation with practitioners</td>
<td>Trained for creation/reading</td>
<td>Don’t understand</td>
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<td>Legal aspects</td>
<td>Recognized legal status</td>
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Clinical Document Architecture (CDA)

Clinical documents
- Defined: authenticated part of clinical record, less like EDI and more like a contract
- Human readability: required
- Machine readable (coded data): option, defined by templates, per use case

"Architecture": constrain for specific use cases
- Continuity of Care
- Discharge Summary, H&P, etc.
- Healthcare Associated Infections
- Quality Reporting...

Idiosyncratic to conform to V3 methodology
- Ideal: data imported into, exported out of documents seamlessly through V3 API
- Reality: V3 messaging impractical

Some things work well, some not so well
- Good: human readability, single stylesheet rendering, consistent metadata
- Not so well: template definition complex, narrative/coded data management difficult
- No comparable messaging/API
FHIR in Context

Liora Alschuler
FHIR

Updated to current syntax, APIs
  o JSON &/or XML
  o RESTful services
  o Digital signature defined
  o Single sign-on defined

Unified model/structure for messages, documents, APIs
CDA & FHIR

Reference Information Model
- Highly abstract
- Act, Participation, Role...

Refined Information Model
- Generic CDA
- Observation, Procedure, etc.

Templated CDA
- CCD or C-CDA or QRDA
- Allergy – Intolerance Observation, Problem Observation, etc.

Resource
- FHIR component for msg, doc
- AllergyIntolerance, Condition, etc.

Profile
- Localized resource
- DAF-AllergyIntolerance, DAF-Condition, etc.

DAF stands for Data Access Framework, a US Realm FHIR Implementation Guide

Track 2: Technology Transformations in Health Care
FHIR Fundamental

Rick Geimer
About REST and Resources
“Representational state transfer” – an architecture for how to connect systems

Outcomes

- Simple stable interfaces
- High Performance / Scalability
- Visible Process (e.g., can debug)
- Portability
- Reliability (resistance to failure)
REST Operations

CRUD(E):
Create – create a new instance of data
Read – get the content (state) of an instance of data
Update – change the content of an instance of data
Delete – remove the instance of data

Execute – get the instance of data (?) to do something for you
FHIR Resources

Administrative
  o Patient, Practitioner, Organization, Location, Coverage, Invoice

Clinical Concepts
  o Allergy, Condition, Family History, Care Plan

Infrastructure
  o Document, Message, Profile, Conformance
Business Operations in FHIR

Register a patient:
  o Create a Patient Resource

Admit a patient:
  o Create an Encounter Resource

Move a patient from one bed to another
  o Find and update the encounter resource

Prepare a list of medications to administer
  o Search through the medication prescriptions for a patient (and then apply logic)
The FHIR Framework
Scope - Domains

- Clinical Records
- Medication Management
- Diagnostic Ordering and Reporting
- Device management & data collection
- Appointments, Administration and Billing
- Clinical Referrals
- Decision Support
- Security / Infrastructure
Scope - Contexts

Internal Application APIs (plug-in extensibility)

Integration inside and between healthcare institutions
  - Continuity of care
  - Secondary data use (public health, quality, research, safety)

Health information exchanges

Internet Web Portals

National Health Records (for nations that recognize that concept)

New applications: ex: Social Web healthcare monitoring (Healthbook)
Guide to the Specification

This is the Continuous Integration Build of FHIR (will be incorrect/inconsistent at times). See the Directory of published versions.

Welcome to FHIR®

First time here? See the executive summary, the developer’s introduction, or the clinical introduction, and then the FHIR overview/roadmap. See also the open license (and don’t miss the full Table of Contents).

Major Sections:

- General Documentation
- Implementation & Exchange
- Clinical Resources
- Administrative Resources
- Infrastructural Resources
Guide to the Specification (cont.)

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Guide to the Specification (cont.)

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This page is provided to help find resources quickly. There is also a more detailed classification, ontology, and description.

**Clinical**

**General:**
- AllergyIntolerance 0
- Condition (Problem) 0
- Procedure 0
- ClinicalImpression 0
- FamilyMemberHistory 0
- RiskAssessment 0
- DetectedIssue 1

**Care Provision:**
- CarePlan 0
- Goal 0
- ReferralRequest 0
- ProcedureRequest 0
- NutritionOrder 0
- VisionPrescription 0

**Medication & Immunization:**
- Medication 0
- MedicationOrder 0
- MedicationAdministration 0
- MedicationDispense 0
- MedicationStatement 0
- Immunization 1
- ImmunizationRecommendation 1

**Diagnostics:**
- Observation 4
- DiagnosticReport 3
- DiagnosticOrder 1
- Specimen 1
- BodySite 0
- ImagingStudy 0
- ImagingObjectSelection 0

**Identification**

**Individuals:**
- Patient 5
- Practitioner 3
- RelatedPerson 0

**Groups:**
- Organization 4
- HealthcareService 0
- Group 0

**Entities:**
- Location 1
- Substance 0
- Person 1

**Devices:**
- Device 0
- DeviceComponent 0
- DeviceMetric 0

**Workflow**

**Patient Management:**
- Encounter 0
- EpisodeOfCare 0
- Communication 0
- Flag 0

**Scheduling:**
- Appointment 0
- AppointmentResponse 0
- Schedule 0
- Slot 0

**Workflow #1:**
- Order 0
- OrderResponse 0
- CommunicationRequest 0
- DeviceUseRequest 0
- DeviceUseStatement 0

**Workflow #2:**
- ProcessRequest 0
- ProcessResponse 0
- SupplyRequest 0
- SupplyDelivery 0

**Infrastructure**

**Information Tracking:**

**Documents & Lists:**

**Structure:**

**Exchange:**
Example Resource Definition

Practitioner (Resource)

- identifier: Identifier 0..*
- name: HumanName 0..1
- telecom: Contact 0..*
- address: Address 0..1
- gender: CodeableConcept 0..1 <<AdministrativeGender>>
- birthDate: dateTime 0..1
- photo: Attachment 0..*
- organization: Resource(Organization) 0..1
- role: CodeableConcept 0..1 <<PractitionerRole>>
- specialty: CodeableConcept 0..1 <<PractitionerSpecialty>>
- period: Period 0..1
- location: Resource(Location) 0..*
- communication: CodeableConcept 0..1 <<Language>>

Qualification

- code: CodeableConcept 1..1 <<Qualification>>
- period: Period 0..1
- issuer: Resource(Organization) 0..1

Resource Root

Resource Component

Simple & Complex elements (may be repeating)
Resource Elements

Resources are defined as an XML structure based on desired wire syntax

Hierarchy of elements

Each element has

- Name
- Either a datatype or nested elements
- Cardinality
  - All collections are nested in a containing element
- Definition
- Coded Elements: Binding to Value Set
<Patient xmlns="http://hl7.org/fhir">
  <id value="glossy"/>
  <meta>
    <lastUpdated value="2014-11-13T11:41:00+11:00"/>
  </meta>

  <text>
    <status value="generated"/>
    <div xmlns="http://www.w3.org/1999/xhtml">
      <p>Henry Levin the 7th</p>
      <p>MRN: 123456. Male, 24-Sept 1932</p>
    </div>
  </text>

  <extension url="http://example.org/StructureDefinition/trials">
    <valueCode value="renal"/>
  </extension>

  <identifier>
    <use value="usual"/>
    <type>
      <coding>
        <system value="http://hl7.org/fhir/v2/0203"/>
        <code value="MR"/>
      </coding>
    </type>
    <system value="http://www.goodhealth.org/identifiers/mrn"/>
    <value value="123456"/>
  </identifier>

  <name>
    <family value="Levin"/>
    <given value="Henry"/>
    <suffix value="The 7th"/>
  </name>
  <gender value="male"/>
  <birthDate value="1932-09-24"/>
  <careProvider>
    <reference value="Organization/2"/>
    <display value="Good Health Clinic"/>
  </careProvider>
  <active value="true"/>
</Patient>
Extensions

FHIR has a standard framework for extensions
  - V2: Z-Segments
  - CDA: foreign namespaces

Every FHIR element can be extended

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.
Governing Extensions

Any system can add extensions to a resource. That doesn’t make it a good idea – they’re only really useful if trading partners understand them.

FHIR has a sliding scale governance for extensions.

- Local Projects
- Domain standards (e.g., Best Practice Cardiology)
- National Standards (e.g., Standard US Realm Extensions)
- HL7 published extensions (corner cases with international scope)
What’s the goal here?

In most areas of healthcare standards, there is wide variability.

- Between systems, countries, institutions, clinicians

**Choices:**

- Specification only supports core – no one can use it
- Specification adds everything – no one understands it
- Specification picks winners – they can use it
- Allow extensions that people can use
  - With governance arrangements

Extensions tame the specification.
Example Extension

Add “Eye Color” to patient resource:
- Pick a URL
- Choose a “type”
- Declare and publish the extension (at the URL)

```xml
<Patient xmlns="http://hl7.org/fhir">
  <extension url="http://acme.org/fhir/patient#eyecolor">
    <valueCode value="brown"/>
  </extension>
</Patient>
...
Narrative

All resources carry an html representation of their content.

It’s a clinical safety issue:
  - The receiver has a fall back option if the system is not sure it fully understands the content

It is not mandatory, but SHOULD be present.

In a closed ecosystem, with extremely tight control and strong conformance testing, it may not be necessary.
  - But things often change over time
  - So using narrative is highly recommended
  - Saves effort when used downstream from the original author
Narrative is XHTML

Formatting allowed:
- Tables, lists, divs, spans
- Bold, Italics, styles, etc.
- E.g., all static content

Features not allowed:
- Objects, scripts, forms – any active content
- Links, Stylesheets, iframes – web context
- Local storage, Microdata (no active content)

Concerns are security and clinical safety.
CDA on FHIR
FHIR Documents

Similar to CDA
Collection of resources bound together
  - Root is a “Composition” resource
  - Just like CDA header
Sent as a Bundle resource
One context
Can be signed, authenticated, etc.
A FHIR document has the same obligations as a CDA document
Documents – are Bundles

- Composition Resource
  - Section
  - Metadata
  - Attester

- Observation Resource
- Device Resource
- Prescription Resource
- Patient Resource

```xml
<Bundle>
  <entry/>
  <Composition />
  <Observation />
  <Device />
  <Prescription />
  <Patient />
</Bundle>
```
The Composition Resource

Composition (DomainResource)
- identifier : Identifier [0..1]
- date : dateTime [1..1]
- type : CodeableConcept [1..1] « FHIR Document Type ? »
- class : CodeableConcept [0..1] « FHIR Document Class ? »
- title : string [1..1]
- status : code [1..1] « CompositionStatus! »
- confidentiality : code [0..1] « v3 Code System Confidentiality! »
- subject : Reference [1..1] « Any »
- author : Reference [1..*] « Practitioner|Device|Patient|RelatedPerson »
- custodian : Reference [0..1] « Organization »
- encounter : Reference [0..1] « Encounter »

Section
- title : string [0..1]
- code : CodeableConcept [0..1] « Document Section ? »
- text : Narrative [0..1]
- mode : code [0..1] « ListMode! »
- orderBy : CodeableConcept [0..1] « List Order ? »
- entry : Reference [0..*] « Any »
- emptyReason : CodeableConcept [0..1] « List Empty Reasons? »

Event
- code : CodeableConcept [0..*] « v3 Code System ActCode?? »
- period : Period [0..1]
- detail : Reference [0..*] « Any »

Attester
- mode : code [1..*] « CompositionAttestationMode! »
- time : dateTime [0..1]
- party : Reference [0..1] « Patient|Practitioner|Organization »
The CDA on FHIR Project

Formal project of the HL7 Structured Documents Working Group (SDWG).

Goals:

- Express the CDA use case using FHIR syntax.
- Move away from the complexities of HL7 V3.
- Ensure a unified model and API for both messages and documents.
The Argonaut Project

Goal: develop a first-generation FHIR API and Core Data Services specification for expanded information sharing of electronic health records, documents, and other health information.

Document related tasks:
- Create C-CDA to FHIR mappings
- Identify CDA/FHIR conflicts and address them in the next release of FHIR
FHIR DSTU 2 Changes

Change from Atom feed to Bundle resource as the packaging mechanism for documents.

Revamp the section narrative and coded data model to be more like CDA.

- The Composition resource now houses all sections and narrative content.
- Individual resources containing coded data are referenced from Composition.

Numerous minor fixes to address C-CDA/FHIR mapping challenges.

CDA on FHIR is now a core part of the FHIR specification.
C-CDA on FHIR

- Ongoing project.
- Will take the Argonaut C-CDA to FHIR mappings and build FHIR profiles for C-CDA.
- Requires more work with HL7 Working Groups and other stakeholders.
- Next steps to be discussed at the fall 2015 HL7 Working Group Meeting.
Current Work and Status of FHIR

Rick Geimer
### FHIR Timeline (planned)

- **2011**: First Draft
- **2012**: 1st DSTU
- **2013**: 2nd DSTU
- **2014**: 1st Norm.
- **2015**: ~2nd DSTU
- **2016**: DSTU 2.1
- **2017**: ~1st Norm.
- **2018**: ~2nd Norm.
- **2019**
- **2020**
DSTU 2

Publish Sept 2015

Expected content includes:

- Updates to existing content
  - Check tracker for proposal and agreed changes
- Additional capabilities
  - Publish/subscribe, Web-based “push”, Operations
- New resources
  - Referral, Coverage, Claim, Diet, Common Data Element
- Profiles for CCDA 1.1
What does DSTU mean?

“...all aspects of the FHIR specification are potentially subject to change”
Maturity Levels

Intended to indicate level of stability of individual FHIR resources and profiles

- FMM1 – Resource is “done”, no build warnings
- FMM2 – Tested at approved Connectathon
- FMM3 – Passes QA, has passed ballot
- FMM4* – Tested across scope, published, prototype implementation
- FMM5* – 5 distinct production implementations, multiple countries, 2

Non-compatible changes at level 4 and 5 will face increased hurdles
Normative FHIR

Will include

- Core specification
- Structural resources
- Subset of other resources
  - Some resources won’t go normative right away

Future releases

- Add more resources
- Add profiles on existing resources
- May add elements to resources
  - Very rare
Where do we go from here?

Liora Alschuler
Is your roadmap on FHIR?

FHIR evaporates “V3 messaging”
V2: if not broke… don’t replace

CDA
  - FHIR retains document concepts
  - Improves text/data management
  - Unified model/syntax with messages/API
  - CDA & C-CDA on FHIR maturing
How do you get there from here?

In the future, we envision a changed standards landscape where:

- Clinical documents and APIs share a common syntax and set of resources;
- Data can be acquired through an API and incorporated into a document or pulled from a document and made available in an API.

In the meanwhile, policy and implementation architectures should:

- Use FHIR where
  - some change in the specification is tolerable as the specification is still in flux
  - the full breadth of healthcare use cases are not required
- Use CDA where
  - Stability of specification critical for investment in clinical information
  - The breadth of use cases are required
- Distinguish between API and document use cases, and retain flexibility while the FHIR specification develops
Lessons

• Highly likely to figure prominently in interoperability
• A work in progress, no promise of stability until ~2017;
• Highly unlikely to hit regulation before then
• V2, CDA/C-CDA, QRDA still required for MU so, build out this infrastructure with forward (FHIR) compatibility
Q&A

Questions?