

SMART on FHIR: the Basics

Renee Cannon
Senior Sales Engineer, InterSystems



Agenda

A Brief History of Health Data and Interoperability Standards

Evolution of HL7® from its beginning to FHIR®

Overview of SMART® on FHIR®

FHIR Integration Capabilities of HealthShare Information Exchange

HealthShare and the SMART on FHIR Framework

Learning Resources

Questions?



Prerequisite for **SMART on FHIR**: the Basics

Basic understanding of data formats (e.g., XML, JSON, Turtle)

Basic understanding of documents, messaging and services

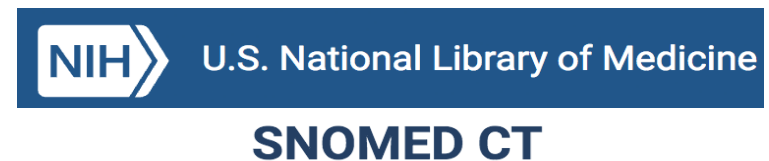
Basic understanding of HealthShare Information Exchange



Most of the concepts we will discuss are trademarked



Clinical Document Architecture (CDA®)



Health Data and Interoperability Standards

Data

Messaging

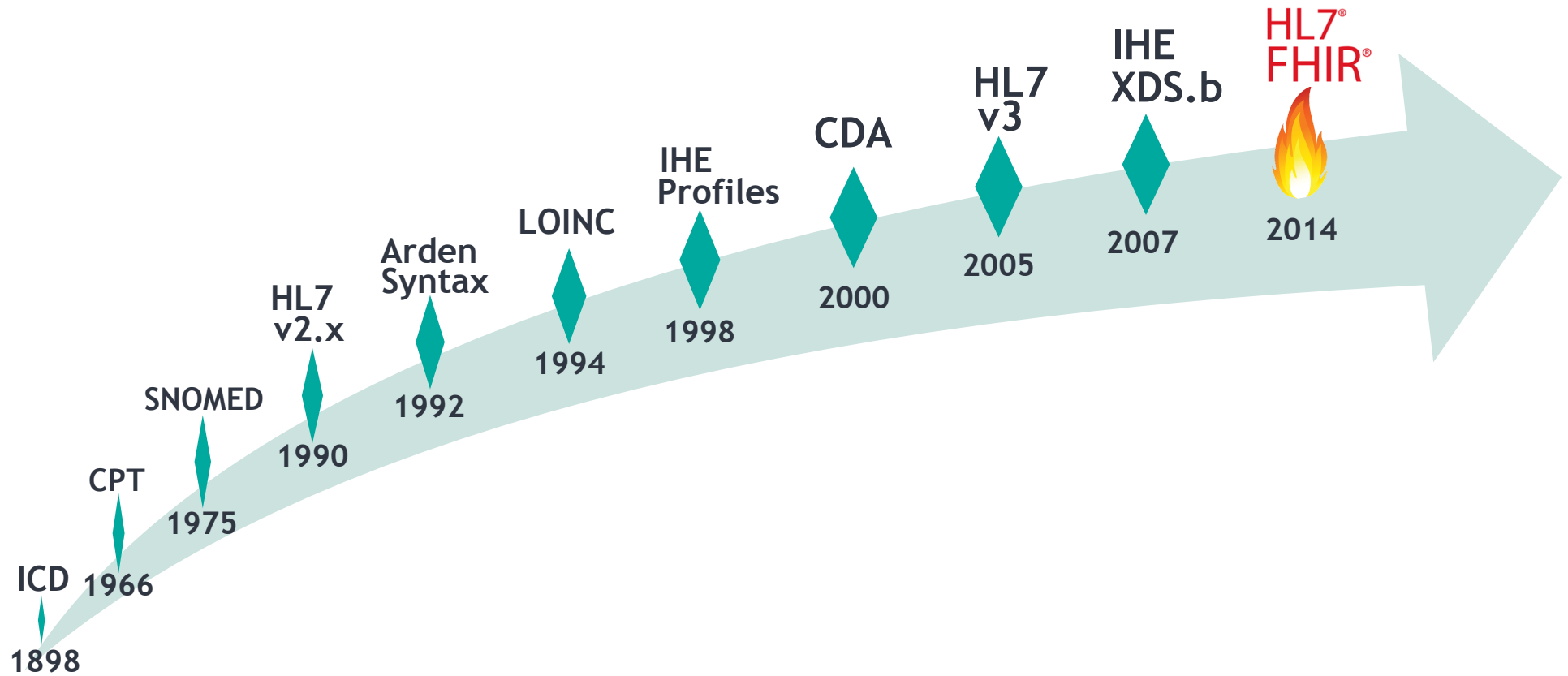
Document

Other standards (e.g., Clinical Decision Support)

Future paradigms

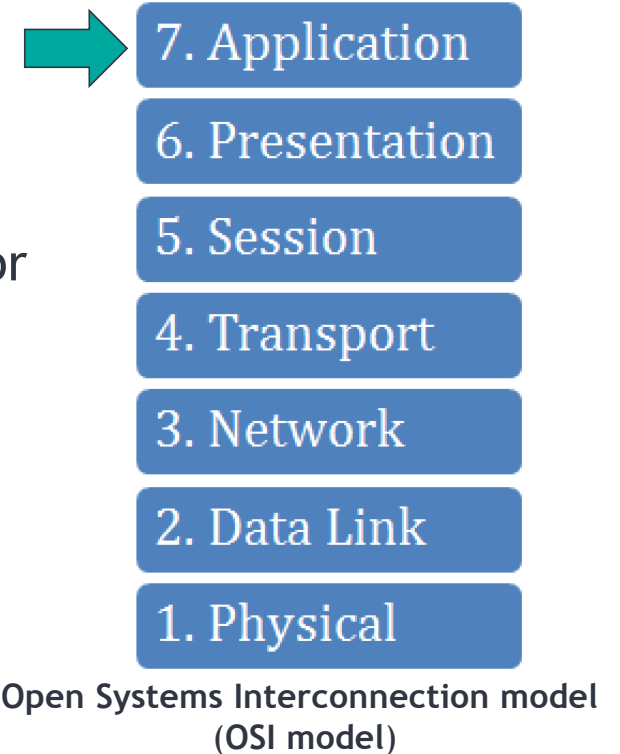


Health IT Standards Continue to Evolve

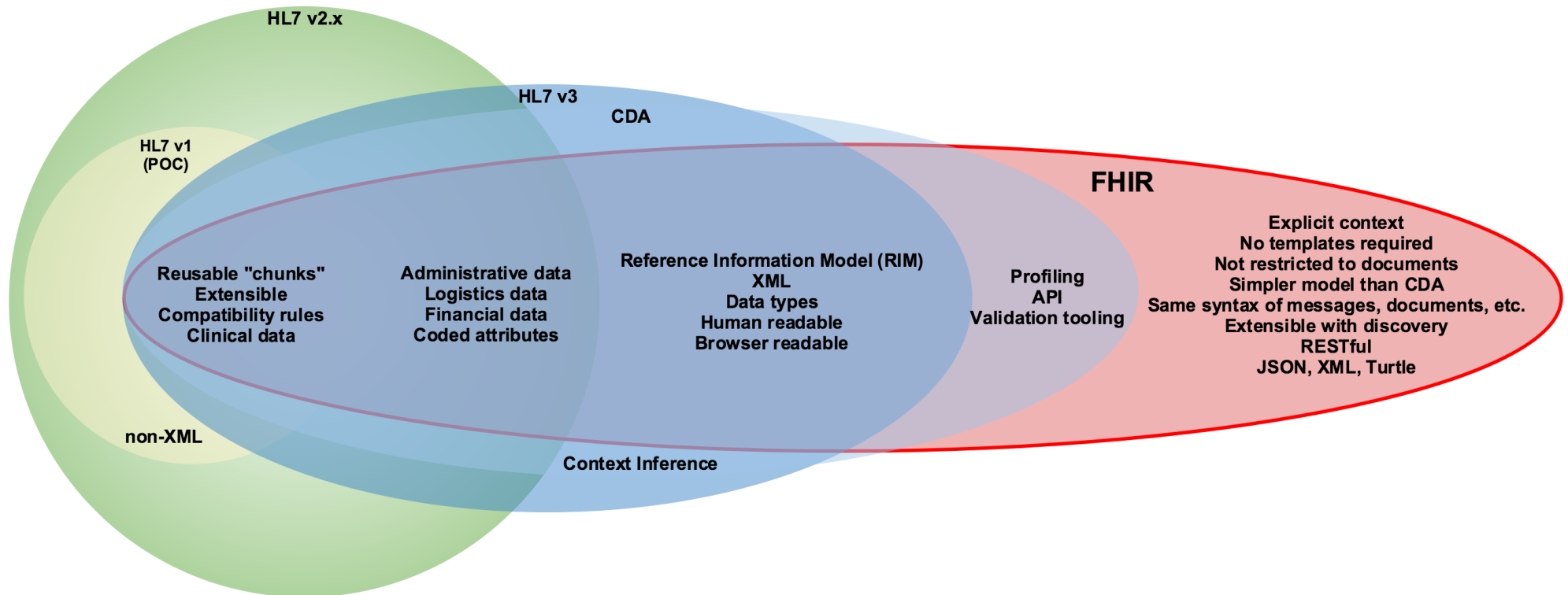


HL7: Health Level Seven

- Founded in 1987
- ANSI-accredited Standards Development Organization
- HL7's mission is to develop standards and framework for global health data interoperability



The Evolution of HL7



JASON to the Rescue



JASON is an independent scientific advisory group that provides consulting services to the U.S. government on matters of defense science and technology.

In the Fall of 2013, The U.S. Department of Health and Human Services (HHS) asked JASON to address the nationally significant challenge of developing comprehensive clinical datasets, collected in real world environments and accessible in real time, to support clinical research and to address public health concerns.

<https://healthit.ahrq.gov/organization/mitre-corporation>



JASON Report Findings

MU Stages 1 and 2 have not achieved meaningful interoperability “in any practical sense” for clinical care, research, or patient access due to the lack of a comprehensive nationwide architecture for health information exchange.

“The current path towards interoperability is based on standards and approaches that are functionally limited and unique to health care. Healthcare industry needs to transition to exchange based on contemporary and scalable architectural principles via development and use of a more **comprehensive set of Public APIs.**”

<https://healthit.ahrq.gov/ahrq-funded-projects/robust-health-data-infrastructure>



Create a New Health IT Standard with Broad Appeal



Executive
Decision Maker



Technology
Decision Maker



Architect



Developer

- Focus on implementers
- Target support for common scenarios
- Leverage cross-industry web technologies
- Require human readability as base level of interoperability
- Make content freely available
- Support multiple paradigms & architectures
- Demonstrate best practice governance





F ast

H ealthcare

I nteroperability

R esources



What is FHIR?



- Fast Healthcare Interoperability Resources (FHIR)
 - A new standard for exchanging healthcare information electronically
 - Based on emerging industry approaches
 - Informed by years of lessons around requirements, successes and challenges
- Achieves semantic interoperability between systems
 - FHIR resources aim to define the information contents and structure for the core information set that is shared by most implementations
 - FHIR does not specify how systems should interoperate



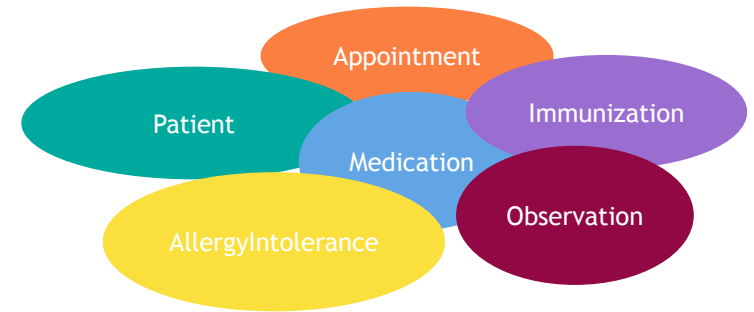
Introductory FHIR Concepts

- Resource
- Extensions
- References
- Bundle
- Composition
- FHIR Document
- FHIR Interaction
- Conformance



FHIR Resource

- Represent granular clinical concepts
- Clinical and administrative
- Can be managed in isolation, or aggregated into complex documents
- Each resource has a known identity (a URL) by which it can be addressed
- Contains a set of data items as described by the definition of the resource type
- Has an identified version that changes if the contents of the resource change



From hl7.org and wiki.hl7.org



Let's build a FHIR resource

Here is the narrative of our heart rate measurement:

id: heart-rate

meta:

status: final

category: Vital Signs (Details : {http://hl7.org/fhir/observation-category code 'vital-signs' = 'Vital Signs', given as 'Vital Signs'})

code: Heart rate (Details : {LOINC code '8867-4' = 'Heart rate', given as 'Heart rate'})

subject: Patient/example

effective: The First Day of Global Summit 2017

value: 127 beats/minute (Details: UCUM code /min = '/min')



Let's build a FHIR resource - Type and ID Declaration

Our heart rate measurement is represented by a FHIR **Observation** resource, which has a unique identity (assigned by the server that stores it) and metadata that describes which FHIR profile this resource complies with:

```
"resourceType": "Observation",  
"id": "heart-rate",  
"meta": {  
  "profile": [  
    "http://hl7.org/fhir/StructureDefinition/vitalsigns"  
  ]  
}
```



Let's build a FHIR resource - Category

We include a **category** array to classify the type of observation and we add a code object to indicate the “name” of the observation:

```
"category": [  
  {  
    "coding": [  
      {  
        "system": "http://hl7.org/fhir/observation-category",  
        "code": "vital-signs",  
        "display": "Vital Signs"  
      }  
    ],  
    "text": "Vital Signs"  
  }  
]
```



Let's build a FHIR resource - Code

We include a category array to classify the type of observation and we add a **code** object to indicate the “name” of the observation:

```
"code": {  
  "coding": [  
    {  
      "system": "http://loinc.org",  
      "code": "8867-4",  
      "display": "Heart rate"  
    }  
  ],  
  "text": "Heart rate"  
}
```



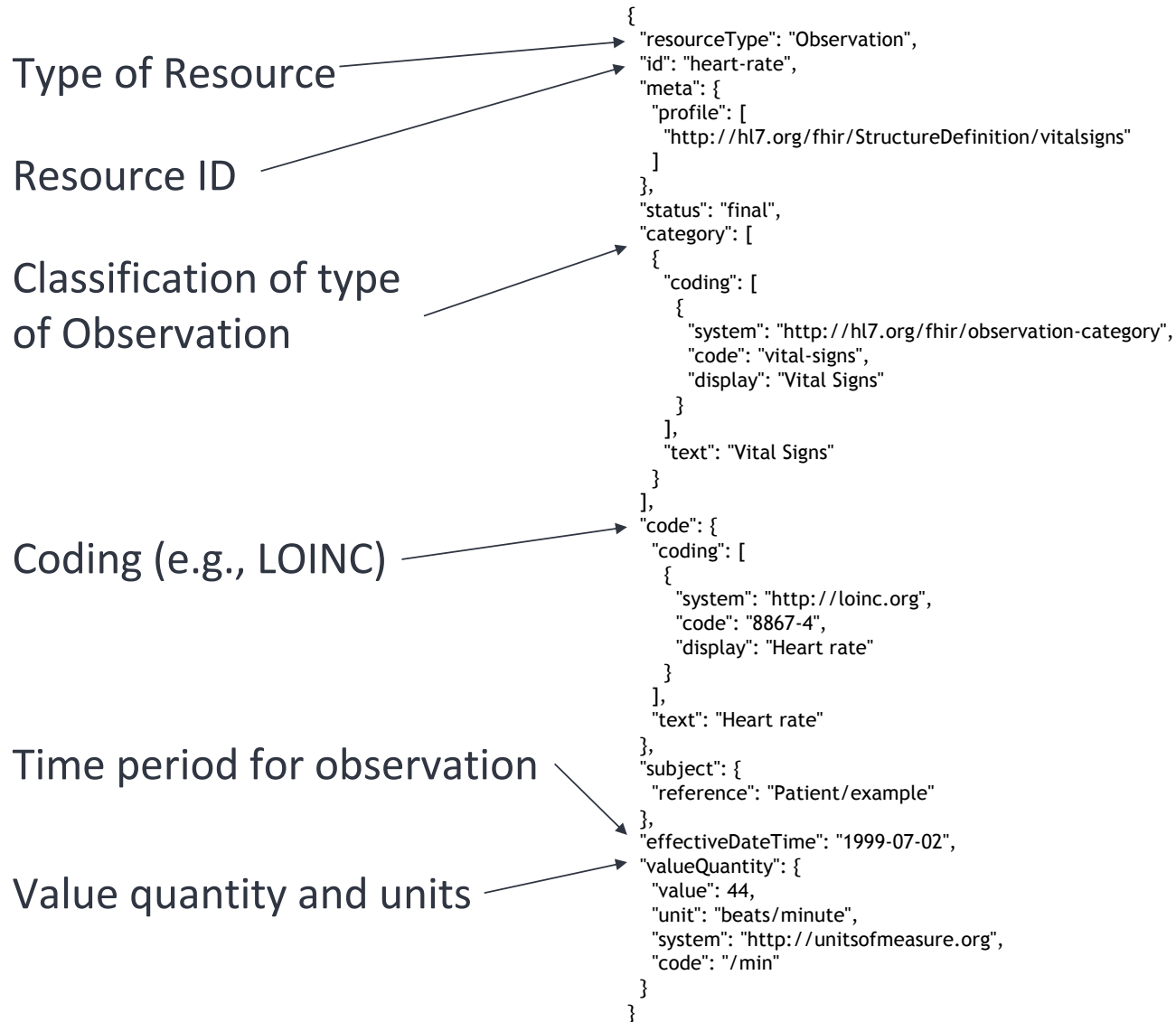
Let's build a FHIR resource - Measurement Value

The value of the measurement and when it was taken:

```
"effectiveDateTime": "2017-09-10T09:30:35+01:00",  
"valueQuantity": {  
  "value": 127,  
  "unit": "beats/minute",  
  "system": "http://unitsofmeasure.org",  
  "code": "/min"  
}
```

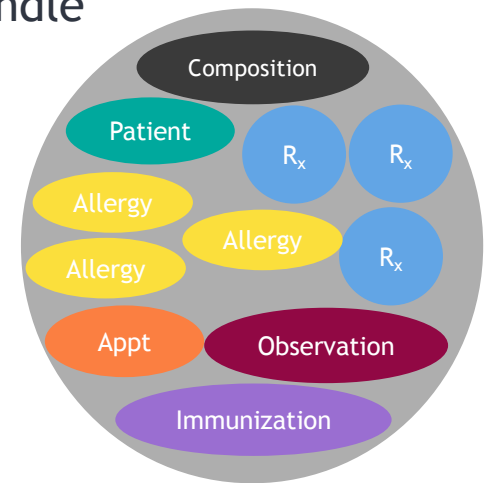


FHIR Observation Resource



FHIR Bundle

- A collection of resources that have an independent existence
- Resources in the bundle can refer to other resources
 - - e.g. an Observation resource refers to a Patient resource
- Resources referenced in the bundle may also be found in the bundle



From hl7.org and wiki.hl7.org



FHIR Composition

- Set of coherent information that is a statement of healthcare information
 - Clinical observations and services
 - Provides a single coherent statement of meaning
 - Establishes its own context
 - Has clinical attestation with regard to who is making the statement
- Although a Composition defines the structure, it does not actually contain the content
 - The full content of a document is contained in a Bundle, of which the Composition is the first resource contained



FHIR Document

- An immutable set of resources with a fixed presentation that is authored and/or attested by humans, organizations and devices
- May be 'clinical' (focused on patient healthcare information)
- May also serve non-clinical purposes
 - e.g. FHIR Implementation guides, practice guidelines, patient handouts



All FHIR Documents Have the Same Structure

- A FHIR document is a bundle of resources of type "document"
 - Has a Composition resource as the first resource in the bundle
 - The Composition resource is followed by a series of other resources
 - referenced from the Composition resource
 - provide supporting evidence for the document
 - The bundle gathers all content of the document into a single XML, JSON or Turtle document
 - The resources include both human readable and computer-processable portions
 - The bundle may also include CSS stylesheets, provenance statements and a signature



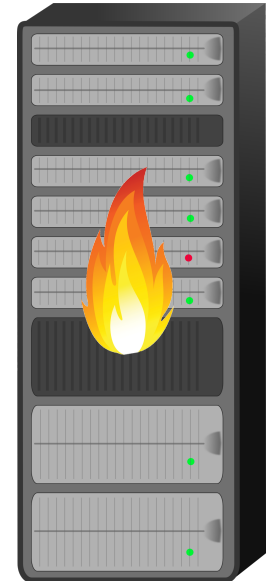
FHIR Interaction

- Manipulate FHIR resources
- The RESTful API describes the FHIR resources as a set of operations (known as "interactions") on resources where individual resource instances are managed in collections by their type
- Servers can choose which of these interactions are made available and which resource types they support
 - Servers provide a Capability Statement that specifies which interactions and resources are supported

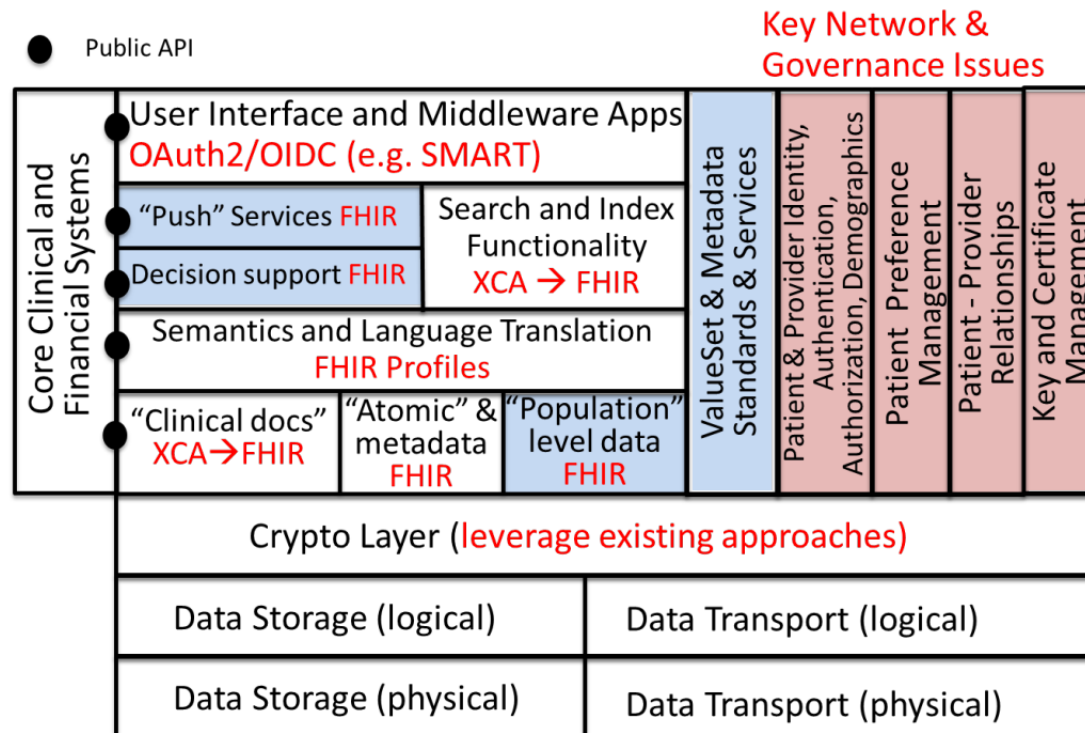


FHIR Conformance

A set of capabilities of a FHIR Server that may be used as a statement of actual server functionality or a statement of required or desired server implementation



Appendix D: Possible Implementation Pathway for Public API



Health Connect FHIR Capabilities

Support for FHIR® has been added as a new feature starting with Health Connect version 15.01

- FHIR server that can accept and respond to RESTful requests
- FHIR client that can interact with a RESTful FHIR server endpoint
- FHIR message model
- Object model for FHIR resources
 - conforms to the FHIR standard and implements all resource and data types
- Resource repository that stores and indexes FHIR resources
- Transformations to convert data between SDA and FHIR



HealthShare Information Exchange FHIR Capabilities

Starting with version 15.03, HealthShare Information Exchange includes additional FHIR features

- Support for the FHIR Gateway and SMART on FHIR application hosting
 - Enables FHIR access to the Composite Health Record and other services in Information Exchange
- FHIR IHE Profiles



Using FHIR to Achieve Business Process Interoperability

- The ability of diverse business processes to work together, to so-called "inter-operate"
- Typically, BPI is present when a process conforms to standards that enable it to achieve its objective regardless of ownership, location, make, version or design of the computer systems used.



What is SMART® on FHIR?



Substitutable Medical Applications and Reusable Technology (SMART)

A set of open specifications to integrate applications with Health IT systems:

- FHIR specification for structured clinical data
- Authentication using OpenID Connect
- Authorization using OAuth2
- UI integration using HTML5, native and mobile

SMART on FHIR achieves business process interoperability



Farrell, Sam MD

PATIENT: CLARK, SUSAN A. FEMALE AGE: 8y 8m

X

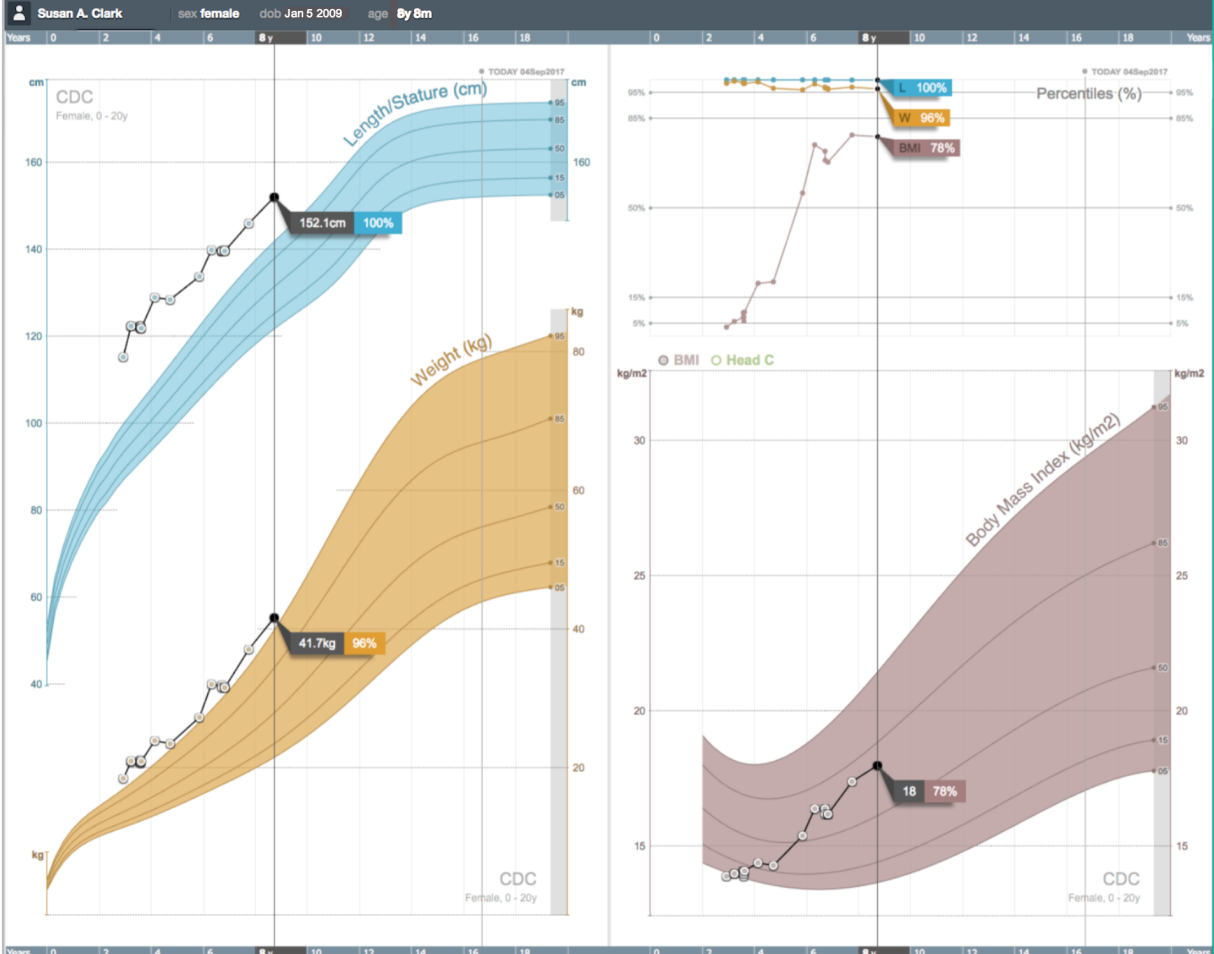
Allergies	Allergies		Vitals			
Conditions	Cat Dander	February 2010	MEASUREMENT	DATE	VALUE	UNITS
Social History	Nuts	March 2017	BP	9/8/2017	101 /72	mm Hg
Medications	Shellfish	December 2016	Temp	9/8/2017	99.1	F
Lab			Weight	9/8/2017	41.7	kg
Mental Health			Height	9/8/2017	152.1	cm
Education			Weight	7/7/2016	37.4	kg
Vitals			Height	7/7/2016	145.8	cm
Documents			Weight	8/17/2015	33.1	kg
Encounters	Immunizations		Height	8/17/2015	140.0	cm
Orders	DTaP	4/13/2017	Documents			
Notes	MMR	6/7/2015	Radiology	4/4/2017		
Procedures	IPV	6/7/2015	Dermatology	3/7/2017		
	Varicella	6/7/2015	Diet Education	3/7/2017		
	PCV	8/12/2009	Radiology	12/22/2016		
	HepB	1/5/2009	HIPAA 2017	12/22/2016		
			Lab	12/22/2016		
	Lab Orders		Intake	12/22/2016		
	Glucose	6/1/2017	Reminder	11/01/2016		
	Allergy Intolerance	2/1/2010	Radiology .	05/09/2016		
			Radiology	07/07/2015		
			Intake	07/07/2015		
			HIPAA	07/07/2015		
Reminders			Allergy Study	02/01/2010		
Immunizations						
Vision						

Farrell, Sam MD

PATIENT: CLARK, SUSAN A. FEMALE AGE: 8y 8m



- Allergies
- Conditions
- Social History
- Medications
- Lab
- Mental Health
- Education
- Vitals
- Documents
- Encounters
- Orders
- Notes
- Procedures
- Growth**
- Reminders
- Immunizations
- Vision



A Real SMART on FHIR Application



Growth Chart
Boston Children's Hospital



Source at: <https://github.com/smart-on-fhir/growth-chart-app>

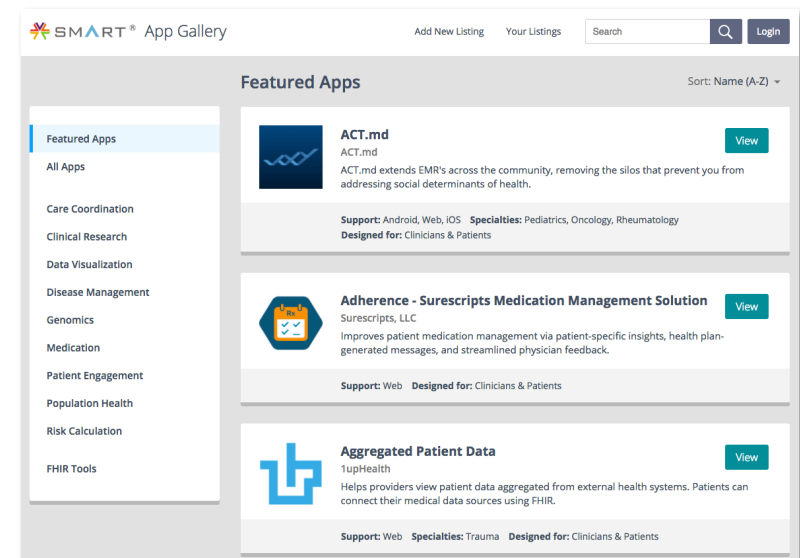
A Big Marketplace for SMART Applications

Individual organizations

- Health information technology vendors
- Healthcare systems
- Academia

Consortia

- Healthcare Services Platform Consortium (HSPC)
- SMART



SMART Application Gallery at apps.smarthealthit.org



SMART on FHIR Applications in HealthShare

HealthShare supports two methods of launching SMART on FHIR apps:

- Embed a SMART on FHIR application in the HealthShare Clinical Viewer
- Standalone SMART on FHIR application



FHIR Gateway Architecture



Data flow



Use HealthShare to deliver FHIR value to end users

Snap-in Data

- HealthShare Information Exchange receives various types of data from various sources then enhances, transforms and delivers the data anywhere
- HealthShare provides a RESTful API for SMART on FHIR applications so that applications can retrieve slices of patient data rather than a large composite (e.g., CDA)

Snap-in GUI

- HealthShare enables you to deliver UX directly to end users by providing applications that can be snapped into existing applications



New FHIR-based IHE Profiles in HealthShare

Three new profiles based on FHIR

- PDQm = Patient Demographic Query for Mobile
- PIXm = Patient Identity Cross-Reference for Mobile
- MHD = Mobile access to Health Documents

Easy learning curve for existing users of HealthShare IHE profiles

- Same basic interaction patterns
- Use existing HS.Message classes
- New Service, Operation and some processes



HealthShare FHIR Development: FHIR Standard

STU3 Support

- Support for the STU3 Resource Model
- SDA $\leftrightarrow$ STU3 Mappings
- DSTU2 $\leftrightarrow$ STU3 Mappings in HS



HealthShare FHIR Development: SDA-FHIR Parity

ALL Data in SDA can be mapped to FHIR

- Utilize FHIR Extensions
- Map Local SDA Extensions to FHIR Extensions

Most Data in FHIR can be mapped to SDA

Automated DTL Building tools

- Map SDA Elements to FHIR elements in spreadsheet-like view
- Generate DTLs from mapping docs



Play with FHIR

FHIR at Global Summit Solution Developers Conference

Additional FHIR Sessions in Desert Salon 5 & 6

- **The FHIR Gateway: Mack Govil**
 - Tuesday at 3PM
 - Wednesday at 9 AM
- **SMART on FHIR Apps for Information Exchange: Gary Monger**
 - Wednesday at 10 AM

Hands-on FHIR in the Experience Lab

- **RESTful FHIR & Messaging in Health Connect**
 - Monday at 3:30 PM
 - Tuesday at 2 PM
 - Wednesday at 11 AM



Next Steps

Where to go from here....

While you are at the Solutions Developers Conference:

- Go see Mack and Gary's sessions
- Engage in detailed technical discussions in the Tech Exchange
- Try it in our hands-on Experience-Lab: RESTful FHIR & Messaging in Health Connect
- Check out FHIR.intersystems.com

Learn how to use the technology showcased in this session by visiting:

- learning.intersystems.com (Online Learning)
- www.intersystems.com/services-support/learning-services/ (Classroom Training)
- docs.intersystems.com (Documentation)

SMART on FHIR application gallery: gallery.smarthealthit.org

SMART on FHIR sandbox: docs.smarthealthit.org/sandbox



Please complete the survey in the event app.

Session recording and slides will be available at:
Learning.InterSystems.com

Search for “Global Summit 2017”

Visit the Tech Exchange to learn more!

The power behind what matters.



Thank you.

