FHIR Overview

Virtual HL7 FHIR Connectathon 26

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Session Goals

- Understand the basics of the FHIR specification
- Understand how to navigate through the FHIR specification website

FHIR License & Terms of use

http://www.hl7.org/fhir/license.html

2.20 License and Legal Terms

FHIR Infrastructure Work Group	Maturity Level: N/A	Standards Status: Informative

2.20.1 Disclaimer and Warning of Use

FHIR Resource definitions developed by HL7 are derived from the considerable collective experience of the HL7 membership and wide community feedback from the development and application of a spectrum of health care interoperability solutions. However, Resource definitions are generalized to support multiple contexts of use. It is the responsibility of the persons or organizations using these Resources to ensure their use is fit for the particular purpose in which they are used, including validation for clinical and operational use.

See also the specific warnings associated with use of the STU.

2.20.2 FHIR License

This specification (specifically the set of materials included in the fhir-spec.zip file available from the Downloads page of this specification) is produced by HL7 under the terms of HL7® Governance and Operations Manual relating to Intellectual Property (Section 16), specifically its copyright, trademark and patent provisions.

What is FHIR?

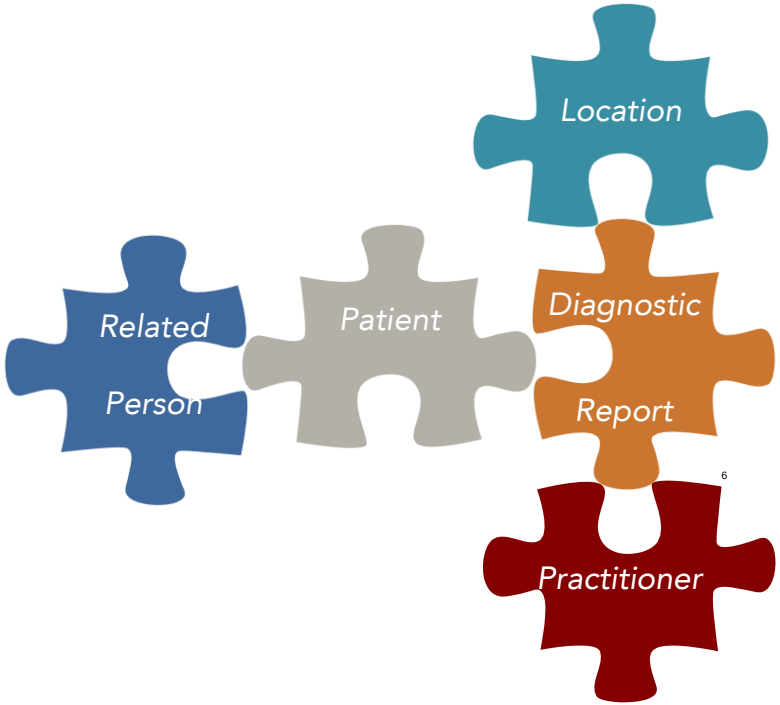
- The Next Generation Standards Framework from HL7
  - Resources (building blocks of independent, discrete data)
  - Extensions (custom data definitions within the specification)
  - Methodology (bundles, profiles, conformance)
  - Support for Multiple Formats: JSON, XML, Turtle(Terse RDF Triple)
  - Human Readable Text (derived from the data content)
- Defines a set of modular data components called "Resources"
- Offers flexibility in implementations; a simple framework to extend beyond the base specification

The Acronym

- F – Fast (to design & to implement)
  - Relative – No technology can make integration as fast as we'd like
- H – Healthcare
  - That's why we're here
- I – Interoperable
  - Ditto
- R – Resources
  - Building blocks – more on these next

It’s All About the Resources…

- Building blocks



Resources

- Defined Structured Data
  - The logical, common contents of the resource
  - Mapped to formal definitions; e.g. RIM & other formats
  - Syntax – XML, JSON and Turtle(Terse RDF Triple)
  - Logical collections of data elements
- Extensions
  - Local requirements, but everyone can use
  - Additional data that isn't part of the original specification
  - Published and managed
- Narrative
  - Human readable

```
<Patient xmlns="http://hl7.org/fhir">
  <id value="example"/>
  <meta>
    <lastUpdated value="2017-01-14T09:14:33Z"/>
  </meta>

  <text>
    <status value="generated"/>
    <div xmlns="http://www.w3.org/1999/xhtml">
      <p>Henry Levin the 7th</p>
    </div>
  </text>

  <extension url="http://hl7.org/fhir/StructureDefinition/us-core-birthsex">
    <valueCode value="M"/>
  </extension>

  <identifier>
    <use value="usual"/>
    <system value="urn:oid:1.2.36.146.595.217.0.1"/>
    <value value="12345"/>
  </identifier>
  <active value="true"/>
  <name>
    <use value="official"/>
    <family value="Levin"/>
    <given value="Henry"/>
    <suffix value="the 7th"/>
  </name>
  <gender value="male"/>
  <birthDate value="1974-12-25"/>
  <managingOrganization>
    <reference value="Organization/example"/>
  </managingOrganization>
</Patient>
```

FHIR Id & Metadata

Human Readable Summary

Extension with reference to its definition

Standard Data Content:

- Patient Identity
- Name
- Gender
- Date of Birth
- Provider

```
{
  "resourceType": "Patient",
  "id": "example",
  "meta": {
    "versionId": "1",
    "lastUpdated": "2017-01-03T16:05:00.792Z"
  },
  "text": {
    "status": "generated",
    "div": "<div xmlns=\"http://www.w3.org/1999/xhtml\"><p>Henry Levin the 7th</p></div>"
  },
  "extension": [
    {
      "url": "http://hl7.org/fhir/StructureDefinition/us-core-birthsex",
      "valueCode": "M"
    }
  ],
  "identifier": [
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      "value": "12345"
    }
  ],
  "active": true,
  "name": [
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      "given": [ "Henry" ],
      "suffix": [ "the 7th" ]
    }
  ],
  "gender": "male",
  "birthDate": "1974-12-25",
  "managingOrganization": {
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  }
}
```
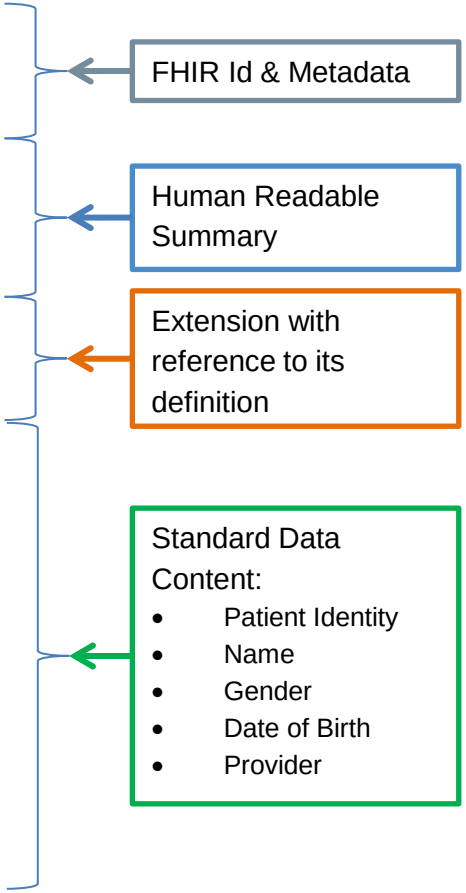




What Types of Resources?

FHIR Resource Types

- Administrative

  Patient, Practitioner, Organization, Location, Coverage, Invoice
- Clinical Concepts

  AllergyIntolerance, Condition, Family History, CarePlan
- Infrastructure/Conformance

  ☆ CapabilityStatement,
  ☆ StructureDefinition

Non-resource types

- Gender

  Too small
- Electronic Health Record

  Too big
- Blood Pressure

  Too specific
- Intervention

  Too broad

CapabilityStatement

- A resource for documenting the capabilities of a FHIR client and server.
- A client should examine the CapabilityStatement of a server to determine the supported behavior of the server.
- The CapabilityStatement:
  - is a key part of the FHIR conformance framework
  - is a statement of the features, rules and behaviors of a FHIR system
  - may be used for system compatibility testing, code generation, or as the basis for conformance testing
- To declare themselves “FHIR Conformant”, a system **MUST** publish a CapabilityStatement:
  - http://hl7.org/fhir/http.html#capabilities

StructureDefinition

- A resource that describes a structured set of data element definitions and their associated rules of usage
  - how resource elements and/or data types are used or not used
  - resource or data type extensions
  - Value Set reference bindings that specify the content of coded elements
- Describes the content defined in the specification
- Describes and constrains (Profiles) how these structures are utilized in implementations
- Published to and shared via registries for use in profile comparison and as the basis for code, report and UI generation

Scenario - Immunization Forecast

- Example: A mother takes her child to Sunset Pediatric Office. The pediatrician needs to determine what vaccination shot(s) are due for the child.
  - What FHIR resources will be used to record this visit and forecast the shot(s) that are due?

(Some) Answers

Recording the visit

- Patient
- Practitioner
- Organization
- Location
- Observation
- Encounter

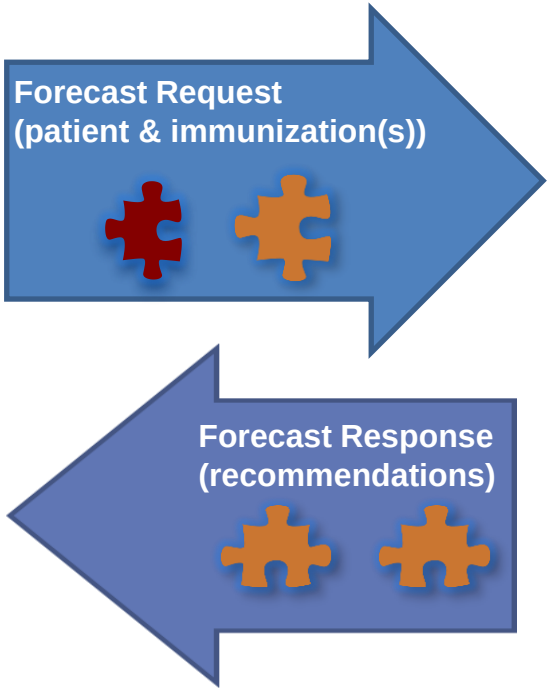
Forecasting the shots

- Patient
- Immunization
- Immunization Recommendation

Let’s see how this would work…

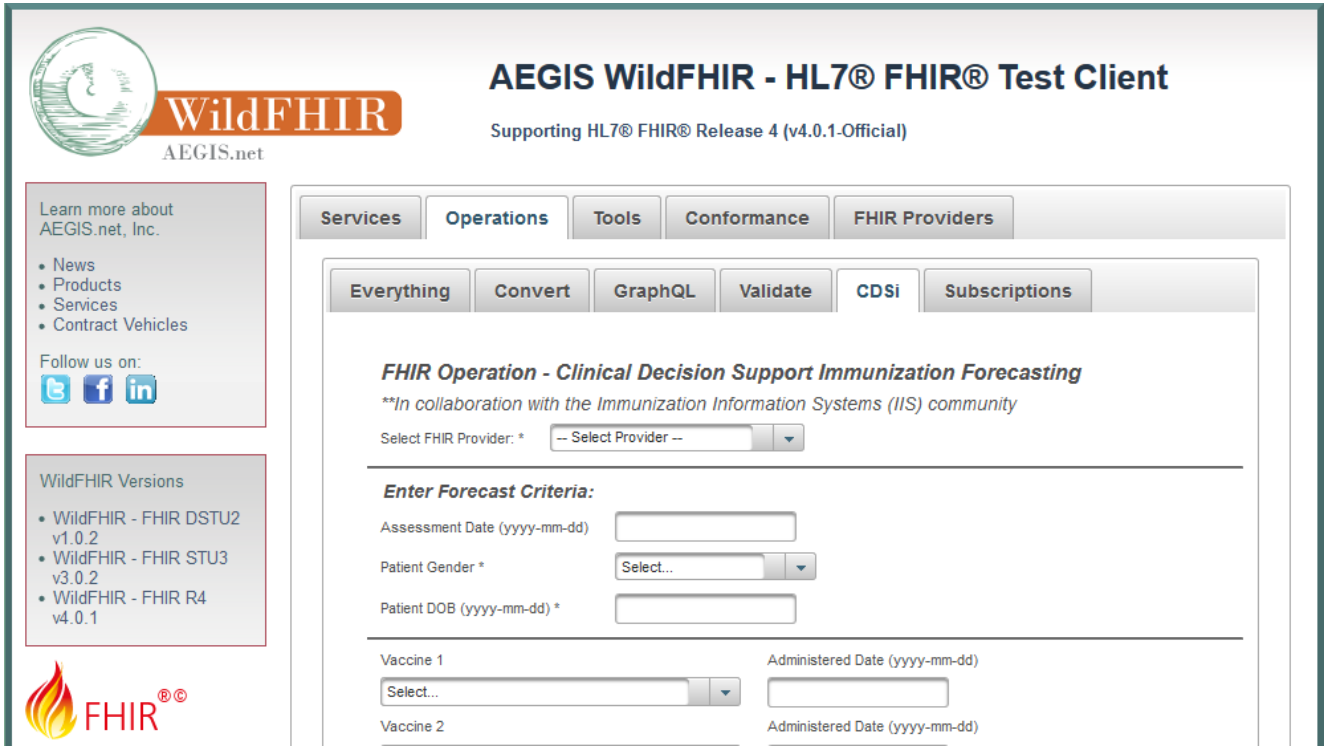
Immunization Forecast Workflow

Sunset Pediatric Office



AEGIS WildFHIR Demo

http://wildfhir4.aegis.net/fhir4-0-1-gui/index.jsf



FHIR Defines Testing

- To ensure interoperability between applications claiming conformance to the specification, a testing framework has been established within the FHIR specification itself
  - http://hl7.org/fhir/testing.html
- This framework defines the TestScript resource as a natural language, computable format of a test case
- The TestScript resource represents an executable test definition for examining the results of FHIR RESTful API interactions
  - http://hl7.org/fhir/testscript.html

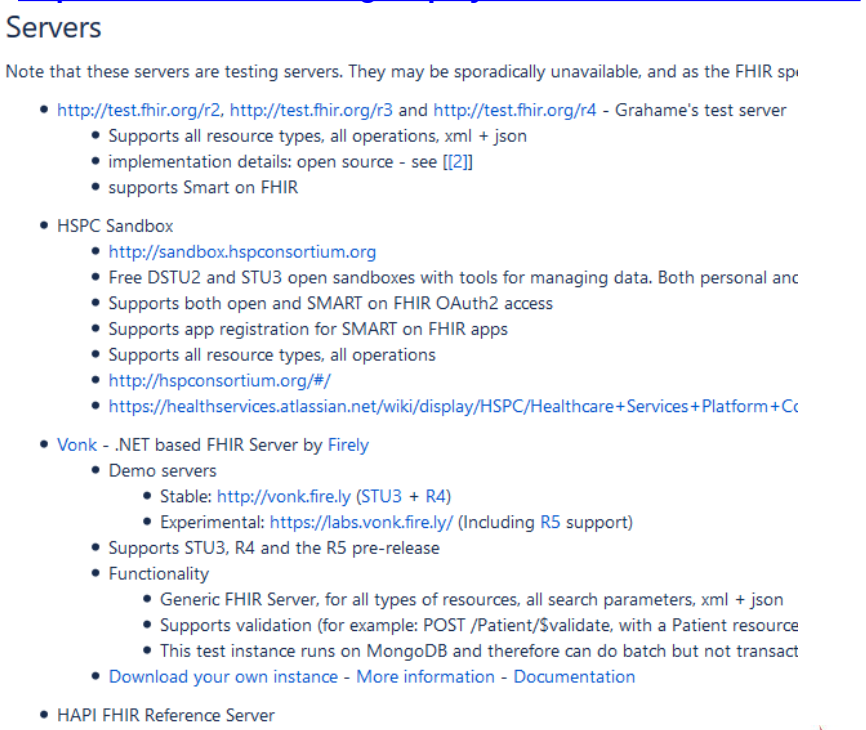
A FHIR Test Engine

- The FHIR TestScript defines the test but how do we run it?
  - A FHIR Test Engine
- What does a FHIR Test Engine need to be capable of doing?
  - Pre-Processing
  - Setup Execution
  - Test Execution(s)
  - Tear-Down Execution
  - Post-Processing
- AEGIS has built such an engine so that others can subscribe to it for testing without having to carry the overhead and expense of setting up their own

Public FHIR Servers for Testing

- More than 30 publicly available test servers (and clients)
- Support for multiple versions:
  - Release 2 (DSTU2)
  - Release 3 (STU3)
  - Release 4 (R4)
  - Release 5 (Preview)
  - Current CI
- Maintained and supported by the FHIR community

https://confluence.hl7.org/display/FHIR/Public+Test+Servers



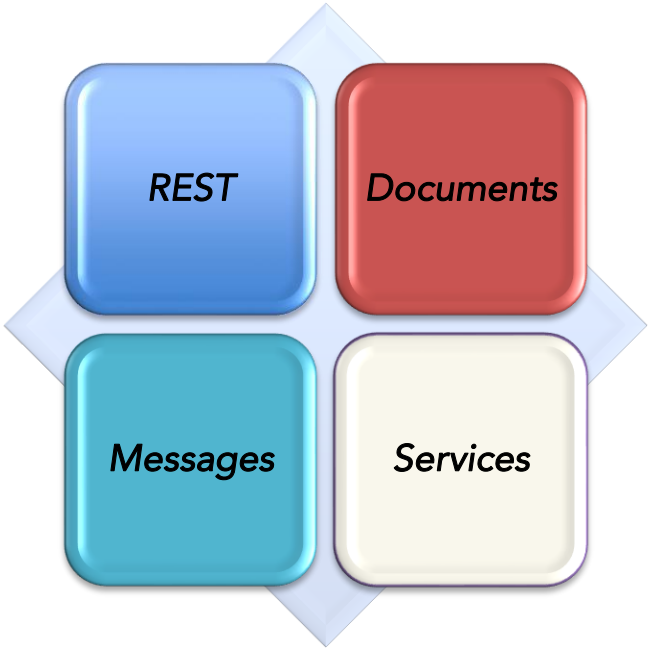
Servers

Note that these servers are testing servers. They may be sporadically unavailable, and as the FHIR sp

- http://test.fhir.org/r2, http://test.fhir.org/r3 and http://test.fhir.org/r4 - Grahame's test server
  - Supports all resource types, all operations, xml + json
  - implementation details: open source - see [[2]]
  - supports Smart on FHIR
- HSPC Sandbox
  - http://sandbox.hspconsortium.org
  - Free DSTU2 and STU3 open sandboxes with tools for managing data. Both personal anc
  - Supports both open and SMART on FHIR OAuth2 access
  - Supports app registration for SMART on FHIR apps
  - Supports all resource types, all operations
  - http://hspconsortium.org/#/
  - https://healthservices.atlassian.net/wiki/display/HSPC/Healthcare+Services+Platform+Cc
- Vonk - .NET based FHIR Server by Firely
  - Demo servers
    - Stable: http://vonk.fire.ly (STU3 + R4)
    - Experimental: https://labs.vonk.fire.ly/ (Including R5 support)
  - Supports STU3, R4 and the R5 pre-release
  - Functionality
    - Generic FHIR Server, for all types of resources, all search parameters, xml + json
    - Supports validation (for example: POST /Patient/$validate, with a Patient resource
    - This test instance runs on MongoDB and therefore can do batch but not transact
  - Download your own instance - More information - Documentation
- HAPI FHIR Reference Server

Paradigms

- FHIR supports four interoperability paradigms



REST

- Simple, out-of-the-box interoperability
- Leverages HTTP: GET, POST, etc.
- Pre-defined operations
  - Create, Read, Update, Delete
  - Also: History, Read Version, Search, Updates, Validate, Capabilities, Batch & Transaction
- Works best where control resides on client side and a trust relationship exists

Documents

- Similar to CDA
- A collection of resources bound together
  - Root is a “Composition” resource
  - Just like CDA header
- Sent as a Bundle **(FHIR Resource)**
- Single context
- Can be signed, authenticated, etc.
- Requires human-readable representation of the data contents

Messages

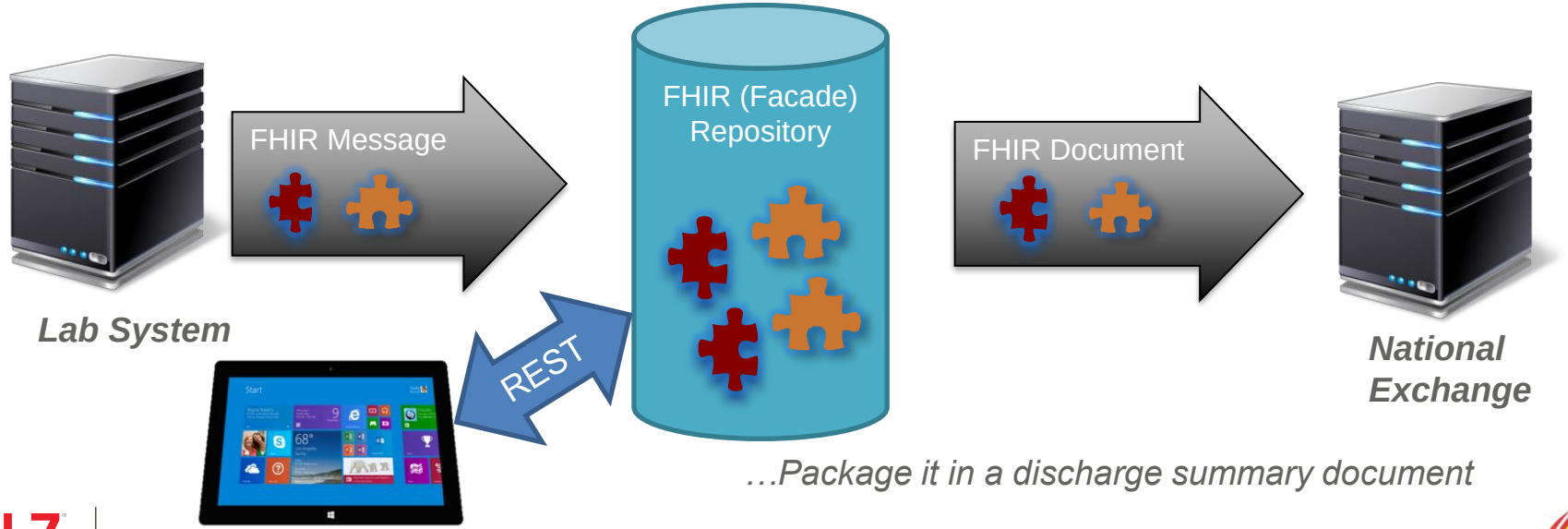
- Similar to v2 and v3 messaging
- Also a collection of resources
  - Sent as a Bundle **(FHIR Resource)**
- Allows for request and response behavior and payloads
- Event-driven
  - e.g. Send lab order, get back result
  - $process-message extended operation
- Can be asynchronous

Service Oriented Architecture (SOA)

- Combination of previous paradigms
  - (based on SOA principles)
    - loose coupling, service abstraction, reusability, autonomy, statelessness, discoverability, composability, interoperability
  - Ultra complex workflows
  - Ultra simple workflows
  - Individual resources or collections **(in Bundle, contained resources or other formats)**
  - Use HTTP or other transport protocol
  - Only constraint is that you're passing around FHIR resources in some way, shape, manner or form

Regardless of the **paradigm** the content **is the same**

Receive a lab result in a message…

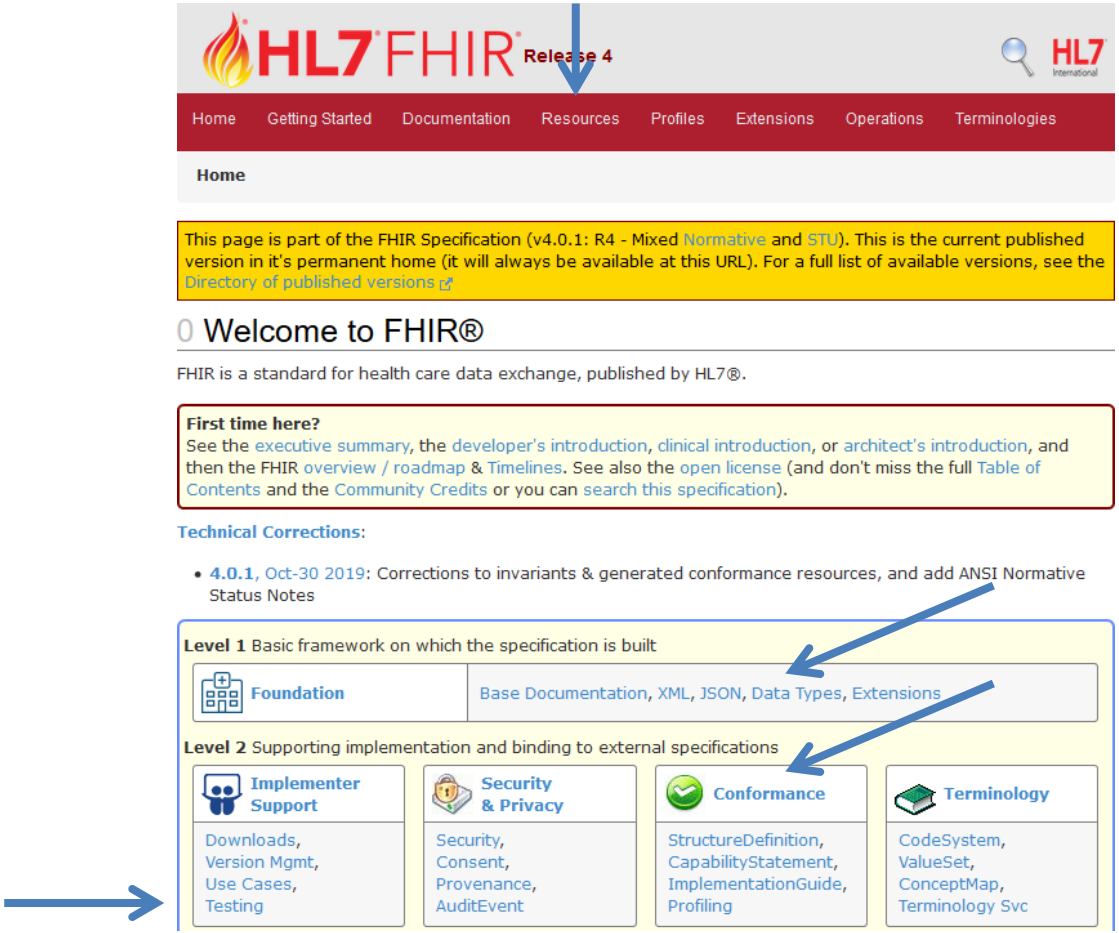


…Package it in a discharge summary document

FHIR Specification

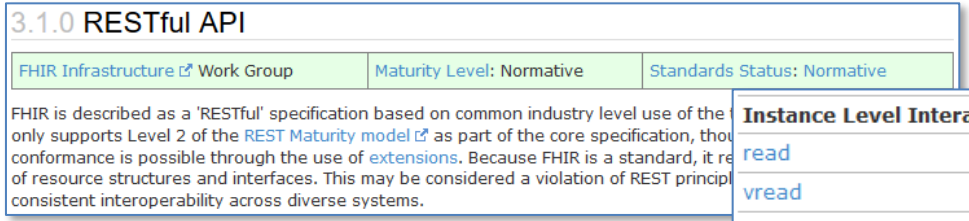
Directory to all FHIR versions: http://hl7.org/fhir/directory.html

Date	Version	Description	Links
Current Versions			
2019-10-30	4.0.1	FHIR Release #4: First Normative Content	
(current)	(last commit)	Current Development build (about 30min behind version control, may be incoherent and change rapidly)	
R5 Sequence (Work in Progress)			
2020-08-20	4.5.0	FHIR Release #5: Preview #3	
2020-05-04	4.4.0	FHIR Release #5: Preview #2	
2019-12-31	4.2.0	FHIR Release #5: Preview #1	
R4 Sequence (Current)			
2019-10-30	4.0.1	**FHIR Release #4** First Normative Content with 1 technical errata (Permanent Home) • *Technical Errata Archive (zip): v4.0.0* *(Permanent Home)*	
2018-11-09	3.5a.0	Special R4 Ballot #3 : Normative Packages for Terminology / Conformance + Observation	
2018-08-21	3.5.0	R4 Ballot #2 : Mixed Normative/Trial use (Second Normative ballot + Baltimore Connectathon)	
2018-04-02	3.3.0	R4 Ballot #1 : Mixed Normative/Trial use (First Normative ballot)	
2018-04-02	3.2.0	Draft for comment / First Candidate Normative Content	
STU 3 Sequence (Historical)			
2019-10-24	3.0.2	**FHIR Release 3** (STU) with 2 technical errata (Permanent Home) • *Technical Errata Archive (zip): v3.0.1*	



RESTful API

http://hl7.org/fhir/http.html



3.1.0 RESTful API

FHIR Infrastructure Work Group	Maturity Level: Normative	Standards Status: Normative

FHIR is described as a 'RESTful' specification based on common industry level use of the
only supports Level 2 of the REST Maturity model as part of the core specification, thou
conformance is possible through the use of extensions. Because FHIR is a standard, it re
of resource structures and interfaces. This may be considered a violation of REST princip
consistent interoperability across diverse systems.

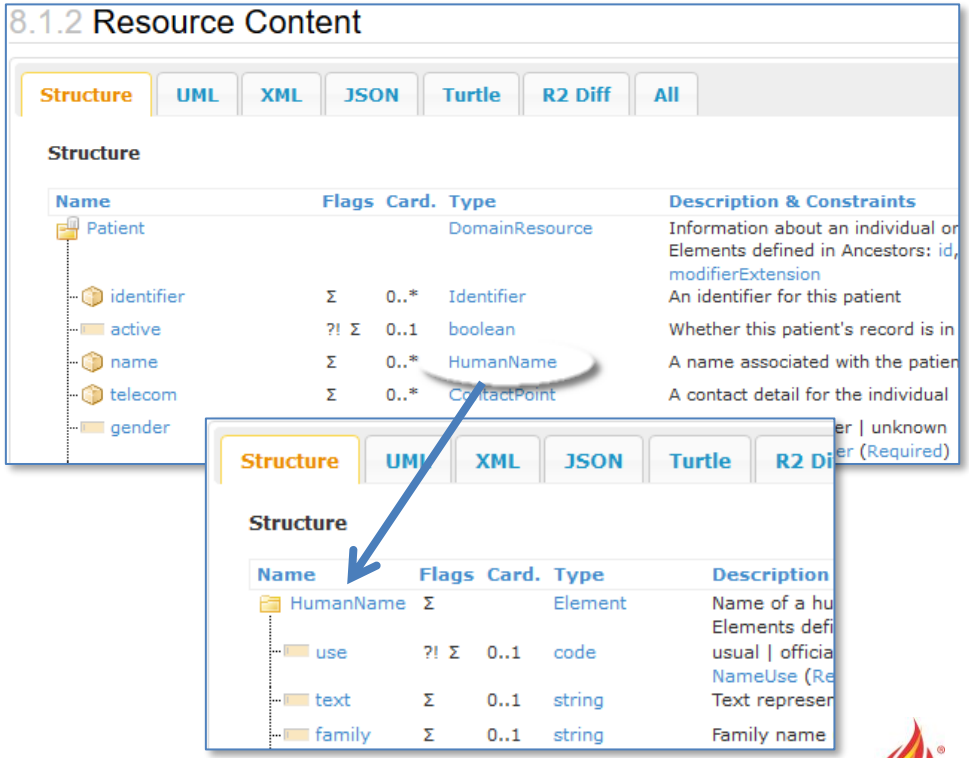
- The Instance Level, Type Level, and Whole System Interactions are listed at the top of the page.
- Clicking on any specific interaction will display the details of that interaction; e.g., update will show all of the FHIR requirements for updating resources.

Instance Level Interactions	
read	Read the current state of the resource
vread	Read the state of a specific version of the resource
update	Update an existing resource by its id (or create it if it is new)
patch	Update an existing resource by posting a set of changes to it
delete	Delete a resource
history	Retrieve the change history for a particular resource
Type Level Interactions	
create	Create a new resource with a server assigned id
search	Search the resource type based on some filter criteria
history	Retrieve the change history for a particular resource type
Whole System Interactions	
capabilities	Get a capability statement for the system
batch/transaction	Update, create or delete a set of resources in a single interaction
history	Retrieve the change history for all resources
search	Search across all resource types based on some filter criteria

Patient Resource Content

http://hl7.org/fhir/patient.html#resource

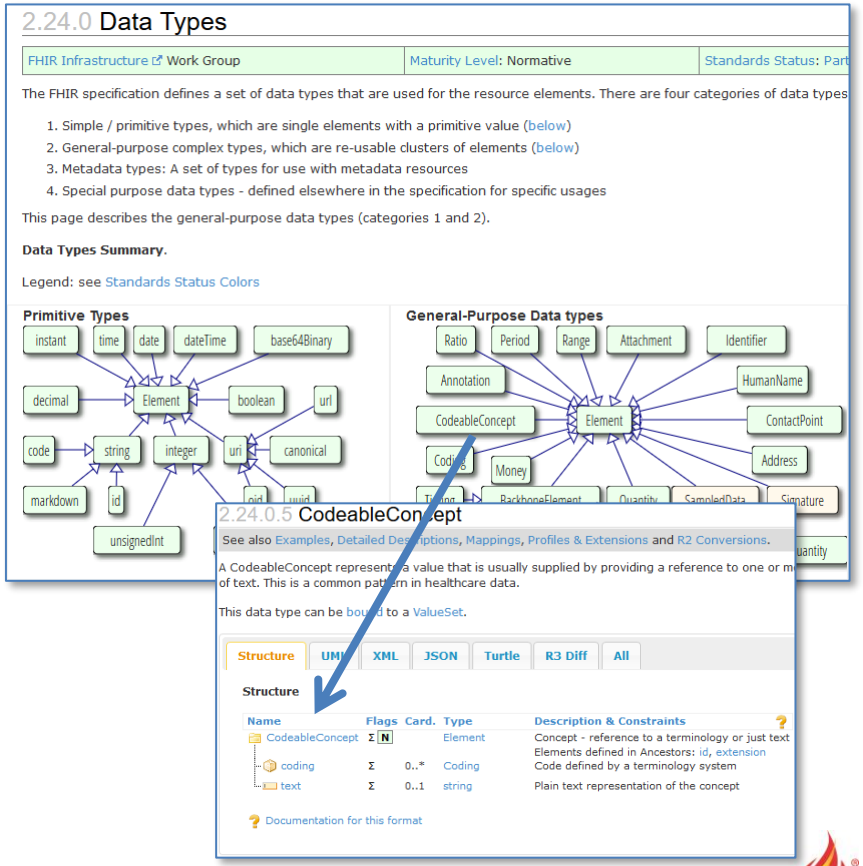
- The Structure tab shows how the resource type elements are organized
- The Card. stands for Cardinality and shows the minimum and maximum number of times an element can appear in an instance. For example, 0..1 means optional, maximum of 1 occurrence.
- The Type lists the FHIR data type of the elements; e.g., name is of type HumanName. Clicking on HumanName will show its structure.



Data Types

http://hl7.org/fhir/datatypes.html

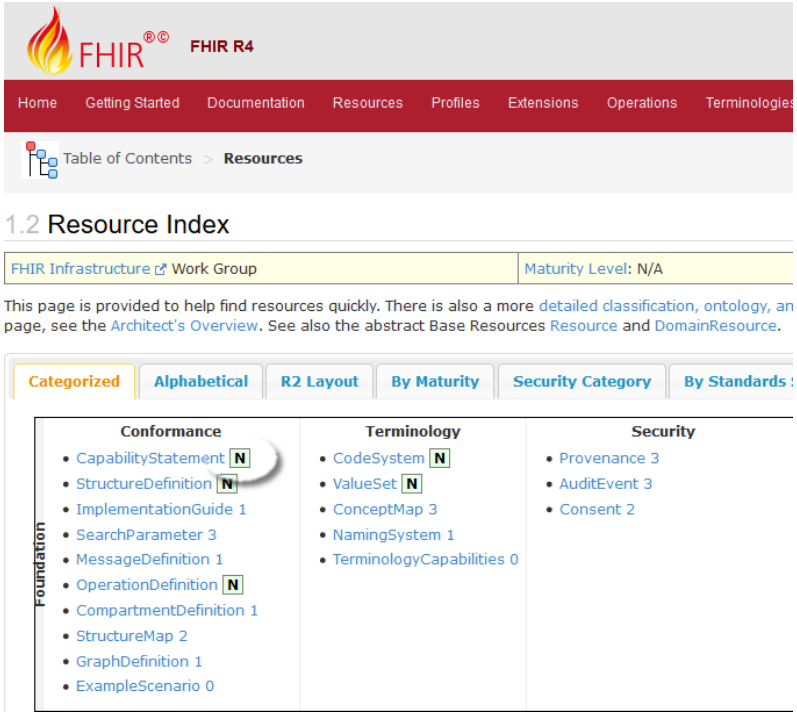
- The Primitive and Complex Types are displayed at the top of the page.
- Clicking on any specific data type will display the details of that type; e.g., CodeableConcept will show the structure of that data type.



FHIR Maturity Model

- 0: Draft
- 1: + No build warnings
- 2: + Successfully exchanged/tested between 3 systems (Connectathon)
- 3: + Verified by WG; formally balloted
- 4: + Scope tested; formal publication; multiple project
- 5: + Published 2+ release cycles; 5+ independent production deployments
- N: Normative

http://hl7.org/fhir/versions.html#maturity

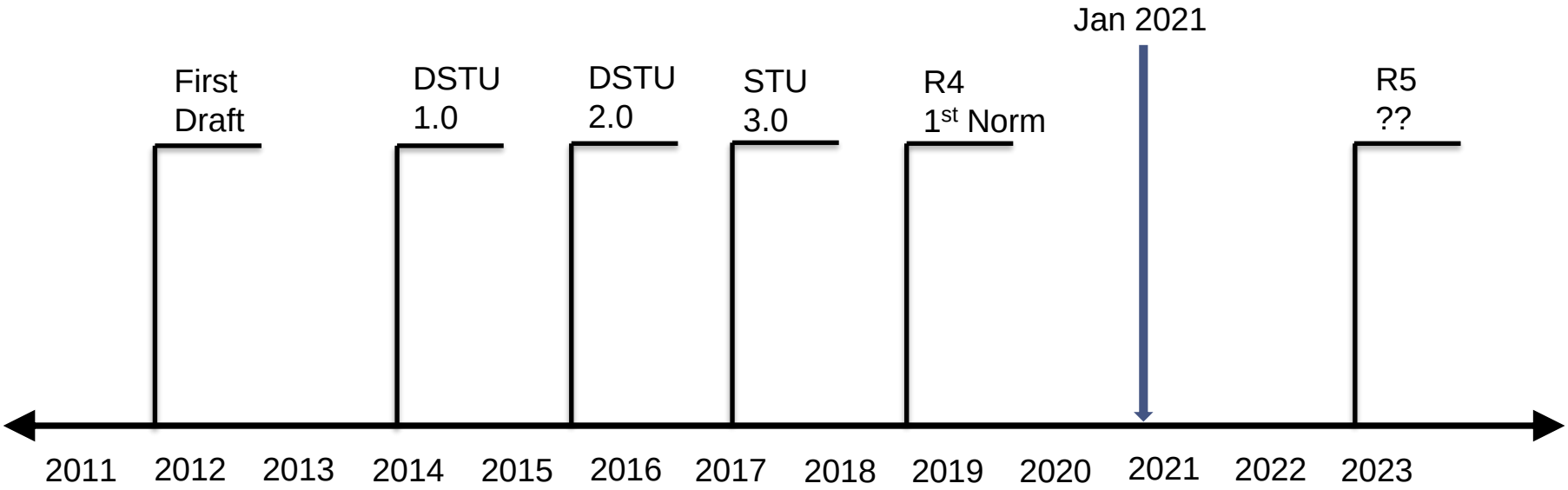


Recap: FHIR Provides…

- Resources (Building Blocks)
- Extensions (Part of the Spec)
- Methodology
  - Bundles, Profiles, Conformance
- Syntax: XML, JSON, RDF(Turtle)
- Human Readability
- CapabilityStatement, StructureDefinition, Testing Framework
- Support for Multiple Paradigms
  - REST, Messaging, Documents, Services
- Extensive online documentation

FHIR Timeline

- FHIR R4 contains the first normative content released December 2018.



Wrap Up

Discussion

Q & A